INDEXED

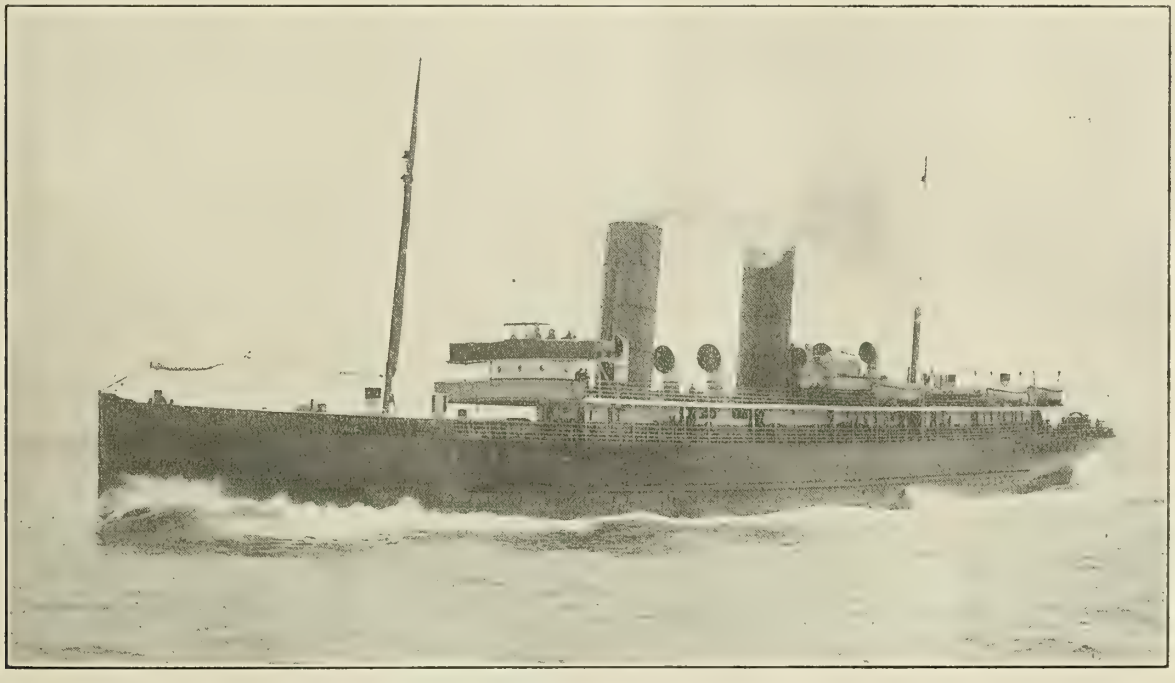
Marine Engineering

NOVEMBER, 1905.

THE TURBINE-DRIVEN STEAMER VIKING.

BY. L. RAMAKERS.

The *Viking*, now just in service, is the first Channel steamer to run from Liverpool with turbine machinery. She was built at the Low Walker yard of Messrs. Sir W. G. Armstrong, Whitworth & Company. We present a longitudinal section of the ship, and a view showing the vessel steaming at 23½ knots, which is the highest speed yet realized by a turbine-driven merchant steamer. The other illustrations will enable the reader to appreciate the interesting character of the ship, and the general excellence of the decoration.



THE NEW TURBINE STEAMER VIKING, ON TRIAL TRIP.

The dimensions are:

Length over all	361 feet
Length between perpendiculars	350 feet
Breadth	42 feet
Depth to upper deck	17 feet 3 inches
Depth to shelter deck	25 feet 3 inches

The subdivision of the vessel into watertight compartments has received special attention, and the principle has been carried so far that the ship will float with any two compartments full of water. The vessel has been built to Lloyd's requirements, and to conform with all the rules of the Board of Trade for a passenger certificate. She should be able to perform the crossing in three hours, and therefore it may be found possible for her to make two double trips every day in daylight. To meet the special requirements of this trade, she is designed to carry a very large number of passengers—nearly 2,000—and to afford them ample accommodation in the way of promenade space, together with extensive facilities for refreshment in the shape of dining saloons. Her shelter deck extends uninterruptedly from stem to stern, a length of 361 feet, and above it is a big promenade deck, about two-thirds this length, which is carried out to the ship's sides, and is thus 42 feet wide at its broadest point. The first-class accommodation is aft and the second-class forward, the middle part of the ship being mainly occupied by the boilers and engine room. The main, upper, and shelter decks are continuous, except in way of the engine and boiler rooms. Abaft the main entrance hall on the shelter deck there are four private cabins and a tea room, close to which there are two of the companion ladders leading to the promenade deck above.

The main saloon is the full width of the vessel, and is lighted by skylight and large rectangular windows at the sides. The woodwork is in dark oak, and a series of black and white reproductions of famous pictures, by well-known artists, forms a pleasing contrast with the dark tones of the somewhat severe paneling, which is also broken by the deep-set window openings and relieved by a simple carved design. The entrance hall is paneled in oak of the same tone as the main saloon, combined with blue and white Dutch tiles.

The ladies' room is entered through folding doors on the port side of the main saloon. It is paneled in sycamore in simple

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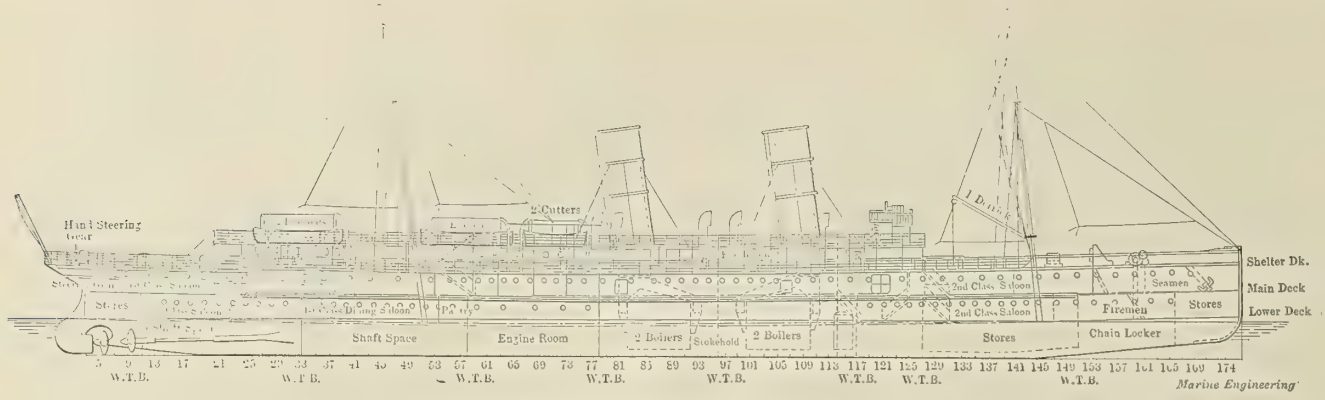


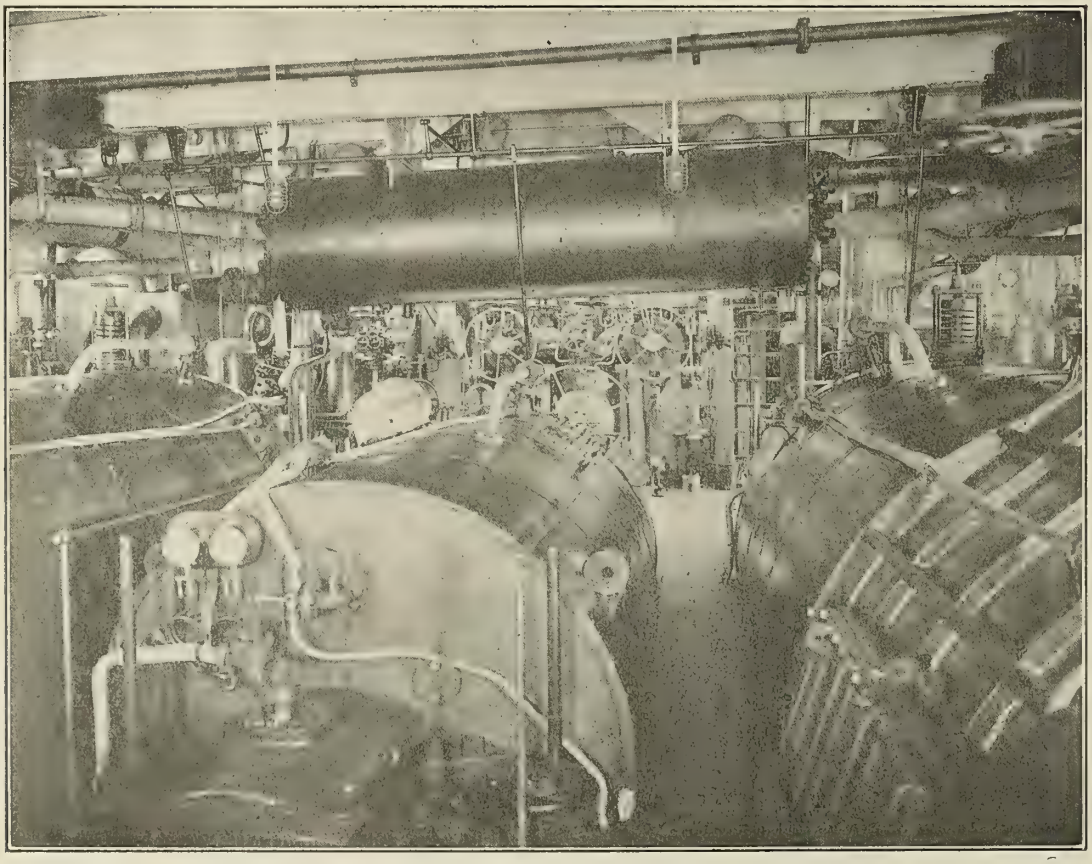
INBOARD PROFILE OF NEW TURBINE STEAMER VIKING.

style, and is lighted by large windows in the ship's side, and by the large light and air trunk, which leads to the dining saloon on the deck below. A large lavatory opens off the ladies' room. At the after end of the main saloon a stairway leads down into another saloon, where accommodation is provided for those who wish to lie down.

The dining saloon is entered by means of a stairway alongside the main entrance to the saloon. It provides seating accommodation for about 100 people, and is decorated with oak paneling. The usual pantry arrangements, with hot plates, lift to the galley, etc., are provided, and all the accessories required to make the service in this department as expeditious as possible. The first-class smoking room is on the shelter deck, and is entered by c s placed just forward of the stairway from the shelter to the upper deck.

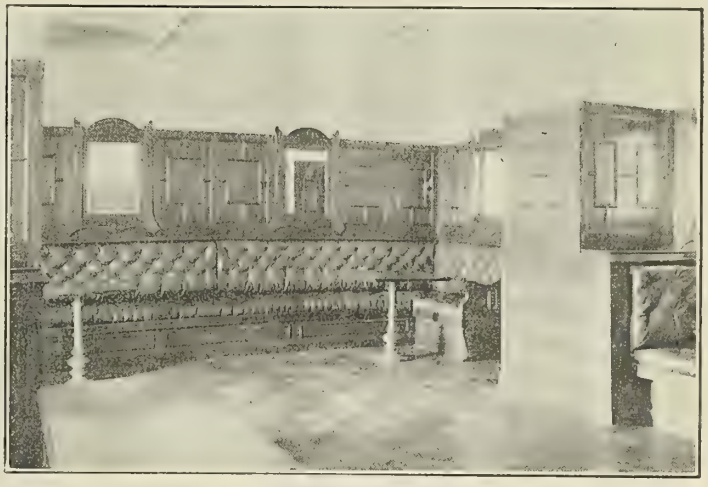
The second-class accommodation is at the forward end of the vessel, and consists of two large general saloons, one of which is arranged for dining, and a ladies' saloon. Lavatory accommodation is provided in convenient places throughout the vessel.

The propelling machinery consists of three sets of turbines manufactured by the Parsons Marine Steam Turbine Company. We give a view of the engine room, looking forward, with the high-pressure turbine in the center; one looking toward the starboard, looking aft; and one showing the starting platform, with all the steam-control wheels. The high-pressure turbine is in the center, with a low-pressure turbine on each side. The surface condensers are in the wings at the after end of the engine room, with the centrifugal circulating pump close alongside them. Two large independent air pumps are fitted conveniently near the condenser, and discharge into a large feed tank, whence the feed water is led to the automatic float-control tank, and so to the two feed pumps. These pumps discharge to the boilers direct, or through an exhaust feed heater on Parsons' patent, which gave very satisfactory results on the trials. The Parsons' patent



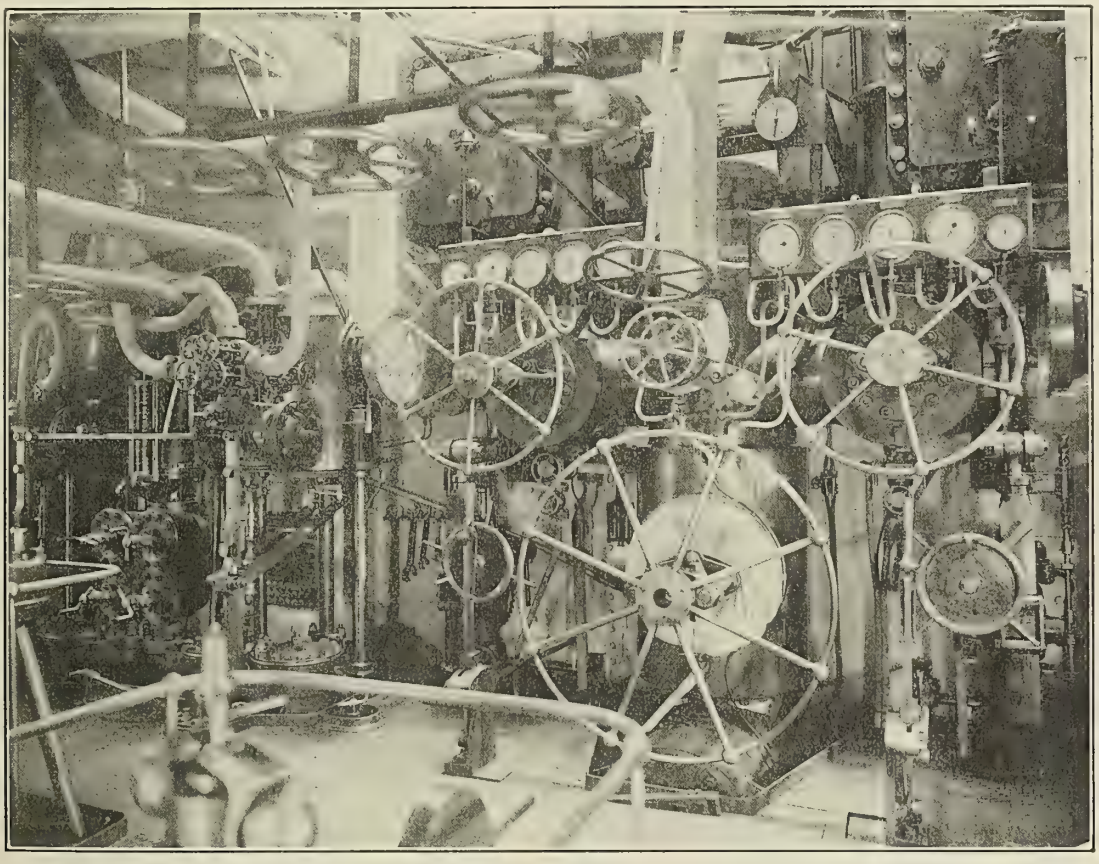
ENGINE ROOM, LOOKING FORWARD, WITH HIGH-PRESSURE TURBINE IN CENTER.

MAIN SALOON ON THE VIKING.



THE SMOKING SALOON.

vacuum augmenter is fitted in connection with the main condenser, enabling a high vacuum to be maintained. The lubrication of the bearings is effected by means of an oil circulating pump, which drives the oil under considerable pressure through all the bearings, and into a cooling and filtering apparatus on its way back to the pump. The stern-way turbines are arranged as usual within the low-pressure casings, and revolve idly *in vacuo* while the vessel is steaming ahead. The three shafts are of Armstrong-Whitworth Openshaw steel, and the propellers of a special bronze mixture worked up to a highly-polished surface. Steam of 160 pounds pressure is supplied by four double-ended boilers, 15 feet in diameter and 19 feet 6 inches long, placed in two boiler rooms separated by a watertight bulkhead. The stokeholds are arranged for forced draft, and the air is supplied by four fans placed in a separate compartment on the shelter deck and communicating with the stokeholds by means of straight air trunks. An emergency exit from each boiler room is arranged through the air lock into the fan room. The funnels are fitted with outer casings which are utilized as up-cast ventilators, and for this purpose are connected to compartments in various parts of the ship. A spark arrester is fitted in each funnel. The result of its trial was most satisfactory, as there was no sign of sparks or cinders when running at the maximum speed.



STARTING PLATFORM OF VIKING, WITH STEAM CONTROLLING WHEELS.

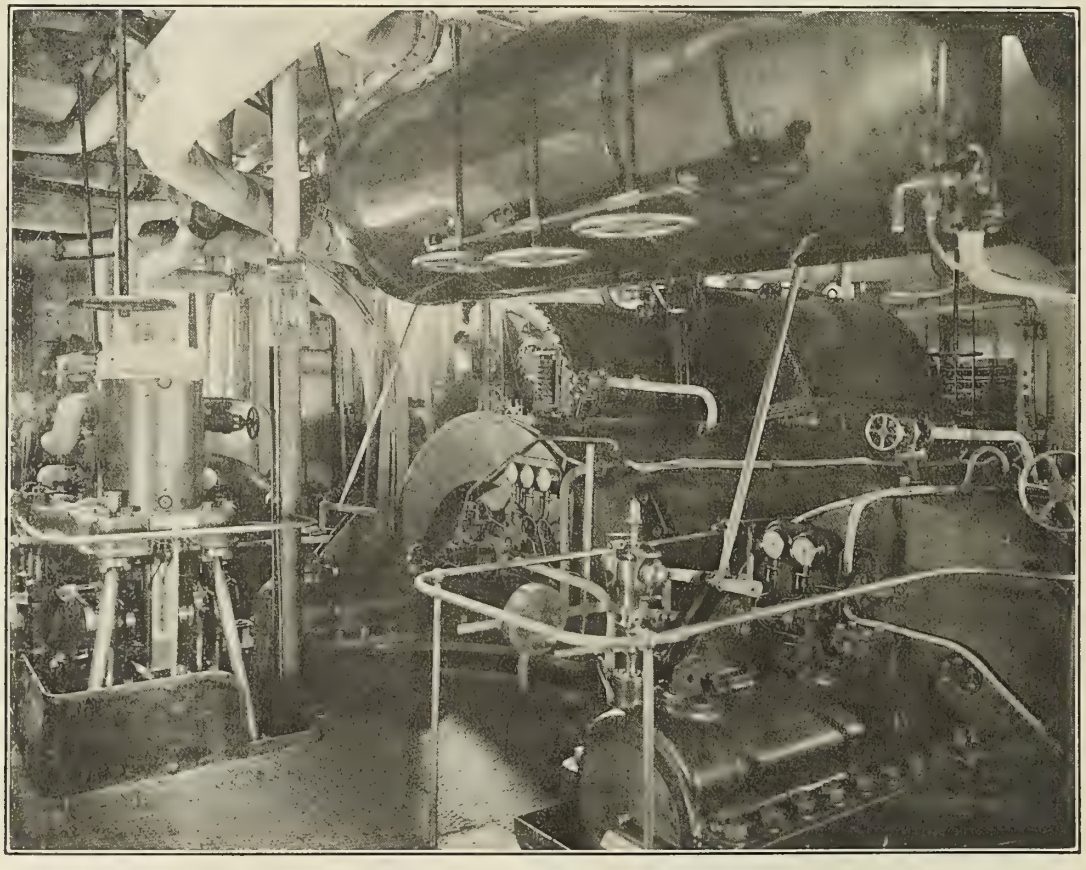
Two sets of trials were carried out besides the builder's preliminary test. The first official trial took place over the measured mile off the mouth of the Tyne, under somwhat unfavorable

THE LADIES' PARLOR.

DINING SALOON OF THE VIKING.

weather conditions. There was a fresh northwesterly breeze and some sea. The air pressure in the stokeholds did not exceed ¾-inch water column, and no attempt was made to develop the maximum power of the boilers. On June 14, the vessel was taken to sea for an extended trial. A course was set from Souter Point to Flamborough Head, 68.277 nautical miles, and the distance was traversed in both directions, care being taken to eliminate, as far as possible, the effect of the tide. The southward run was made at a speed of 23.684 knots, and the northward at 23.375 knots, or a mean speed over the whole distance of 23.53 knots. The vessel was kept at full speed for nearly seven hours. Although the power developed on this trial was higher than on the preliminary trials, there was very considerable reserve in the boilers.

The maneuvring qualities of the ship are very favorable, the turning circle of the vessel at 20 knots speed, with an angle of helm of 38 degrees, was made in 4½ minutes, the diameter of the circle having been 1,475 feet, or 4.2 lengths, and the angle of heel of the ship 3 degrees. The observations were taken during a breeze; and, as the time was short, only one circle was made, with the results given.



ENGINE ROOM, LOOKING AFT AND TO THE STARBOARD.

G. Edward Smith, engineer and naval architect, Philadelphia, Pa., has formed a partnership with W. W. Robinson, under the firm name of Smith & Robinson, and opened offices at 605 Provident Building, Philadelphia, as naval architects, superintendents of construction and repair, etc. Both members of the firm have been connected with the engineering department of the Wm. Cramp & Sons' Ship and Engine Building Company.

THE MERCHANT MARINE.*

BY GEORGE W. DICKIE.

Before a congress representing the commercial interests of the western half of the United States and standing on the western edge of this great country, facing the Pacific Ocean, destined to be the stage on which will be enacted the great commercial development of the future, the subject I have been requested to present to you needs no apology for its introduction.

For the last twenty-five years or so, I have, from time to time, by speech when I found anyone willing to listen and by papers as far as I could find readers for them, endeavored to awaken a sentiment in this country in regard to ocean-borne commerce and its necessity to the future prosperity of the nation. To arouse a sentiment in this country that would result in practical measures for the revival of the merchant marine has been a difficult task, and has tired out many a vigorous advocate of the needs of our shipping; even events that when they were happening were expected to produce great results have not, as yet, had the desired effect. To illustrate this let me quote from an address delivered by me before a body of commercial men in the early part of 1899, showing what I had expected from the events then taking place: "In studying important naval events in which this country has played the leading part, and which will make this period figure largely in naval history, a great fact has impressed itself on my mind, a fact that, if I understand the meaning of these events that have been following each other in rapid succession during the last few months, is going to make a mighty and lasting impression on the immediate future of this country; and this fact is, that the sentiment of this country, relative to the necessity of being a great naval power, has undergone a marked change in the last few months, and that sentiment will assert itself in the councils of the nation with a force that will demand recognition. Who would have ventured to predict the sequence of events that have followed so close on the heels of that declaration, the object of which was to force Spain to free Cuba? and to accomplish this, the President was empowered to use the full force of the army and navy to compel the Spanish to vacate that island. Troops were moved from the west to the east to help in the invasion of Cuba. The battleship *Oregon,* that we had just built to guard the Pacific coast, the only battleship that we had on the Pacific Ocean, was ordered to the Atlantic coast, not in the leisurely way in which battleships reach distant stations, but with few stops and the best economical speed she could make. Other battleships under the same necessity might have accomplished all that the *Oregon* has done, but the fact remains that up to this date (1899) the voyage of the *Oregon* stands alone at the head of ocean voyages made by battleships.

"This movement of troops and our battleship from this coast to the Atlantic was the first national move in the events of the war. While these orders were being carried out, who could have foreseen that the small Asiatic arm of our new navy should have struck such a blow to the Spanish power in Manila as to force a rearrangement of all the plans of the war, and render necessary a large military expedition to the other side of the world? This is somewhat different from ferrying troops to Cuba, and at once shows our weakness in merchant marine. This experience is to be the grand lesson of this war, and in the matter of ocean commerce the lesson will bring forth fruits in the near future. Then the gathering of many thousands of our young men from the middle states, where the sea and all its interests had no part in their daily life, and far less in their ideas of their country's place among the nations of the earth, and transporting them to the Pacific shore, there to board transport ships for the long ocean voyage to Manila, is to be an education to these men, taken as they are from every walk in life, that will bring the sea home to those states with such power as will forever dispel the apathy that has prevailed in the heart of this country for the last twenty-five years in regard to all matters affecting the ocean commerce of this great nation."

These hopes, expressed seven years ago, have not as yet been realized, though much work has been done by those who have the interests of our foreign commerce at heart; yet the outlook is not very bright. Hon. Charles H. Grosvenor, chairman of the congressional committee on the merchant marine, on June 1, writing to those who had been active in the work, says: "In the opinion of the best judges of these events, unless something is done by the next Congress at least, the hope of American shipping interests may as well be abandoned. If, with all the present information we have, Congress and the President will continue to ignore the just measures that have been introduced and promoted by the friends of the American merchant marine, we may as well abandon all future contests and make the best terms with foreign shipping we can." This shows how tired those laboring in the cause of our merchant marine have become, and how much they need that the growing sentiment through the country in favor of a revival of our foreign shipping should be exerted with such force that Congress will not be able longer to withstand the demand for action.

It is self-evident that to any country like this, having an immense seaboard on the two great oceans of the world, great power, both naval and commercial, is a very desirable thing, yet the history and progress of this country shows that, in certain stages in the development of such a country, it is not a prime necessity.

In our earlier history, with the bulk of population centered on the Atlantic seaboard, and dependent on an interchange of products with the "mother" country and her colonies, the energies and accumulated wealth of the people naturally turned to the sea. Behind them were great forests of magnificent material with which to build ships and in front of them the ocean highway to all countries. With such opportunities this young and vigorous nation, in the early part of last century, found an extensive mercantile navy an absolute necessity to its development and growth in power.

The destruction of a portion of the shipping of this country during the civil war is often given as a reason for the rapid decline of the country's foreign shipping trade. It is quite natural to come to such a conclusion, because the civil war happened at the same time as this decline of American shipping, but its absurdity becomes apparent as soon as we think about it. All other properties destroyed during the war, that were needed for the future progress of the country, were replaced in better form than that destroyed. If a city like Chicago is destroyed by fire and the country needs a city in that place, it is restored, grander and better fitted for all purposes than that which was burned. It is so with every product of man's labor, so long as the thing is needed and the man's ability to produce it is not destroyed, anything that destroys or takes away the tools he works with is an incentive for him to devise and produce better tools.

That the shipping interests of the United States did not recover from the injuries received during the civil war, but kept on steadily declining, is in itself an indication that a mercantile navy was not absolutely necessary to the prosperity and development of this country. Other causes operating at the same time, and in conjunction with the destruction of these properties, became powerful factors in preventing a prompt restoration of all ships destroyed.

One of these was the change, then taking place, in the material for the building of ships. The native oak of old England that had enabled her flag to "Brave a thousand years the battle and the breeze," was becoming a very scarce article, and ships being an absolute necessity to her power and position among the nations, a new material must be found out of which to build ships. This new material, iron, had gradually been gaining the confidence of those "who go down to the sea in ships and do business in great waters," and while privateers were burning the best wooden ships that carried the stars and stripes, the British shipyards were learning the most economical methods whereby iron plates and bars could be put into ship shape to carry freight, and not only equal

*Address before the Trans-Mississippi Commercial Congress, sixteenth annual session, Portland, Ore., August, 1905.

the wooden walls in strength and power to carry, but to far excel the best the shipbuilder's art could do in wood. In this new material Great Britain saw her opportunity to not only maintain her position on the sea, but to extend it to a magnitude that has become one of the wonders of the age.

The American shipbuilder and shipowner could see all this going on, and no doubt understood how it would end; but to his country shipbuilding and ship owning were not a national necessity in the same sense as it was to Britain. The necessity was a personal one and not national on the American side, while the position of Great Britain among the nations depends upon her naval supremacy. Hence the British shipbuilder had only to learn his business of building good ships and the government would see that the shipowner did not lack encouragement to use them.

With us, the men who could handle great enterprises were driven from the sea to make great highways for commerce on land. There was a continent to open up, stretching from the great lakes to the Pacific Ocean, and for the United States at that time this was a greater necessity than learning to build ships in iron and steel. So the generation now active in the affairs of this great country is purely and solely a railroad generation; that is to say, the leaders in enterprise among our business people, as a rule, whether in finance or commerce, have been trained to regard the development of railways as the one great and all-absorbing field of enterprise in this country. All other necessities for the best development of the country have been made subordinate to this. Perhaps at no other time in the history of the development of any country has one generation absorbed and brought under the power of civilization such a vast territory as has the present generation in the United States.

To men who could finance such enterprises, the best returns ever received from shipowning were not worth looking at, and, while the wealth of the old world was being scattered through the country for materials and labor to build railroads, where was the necessity for fostering a business that required a new kind of training, and did not present anything like the same opportunities for the getting of wealth?

Thoughtful men, however, throughout the country, especially in states facing the oceans, have been feeling for some time that a change was approaching, and that the time is not far off when this country will find it necessary, even at some cost, to build up an ocean commerce through ships under her own flag. As American wealth increases it must find an outlet on the ocean and our government must find a way to make it profitable to do so, by placing her shipowners on an equal footing with those of other nations with whom they must compete. Look at any railroad map of the United States and note the tangled network of black lines crossing and recrossing it in every direction and you will be forced to the conclusion that, in our generation at least, there is not much room left for more railroads, at any rate not for any more great trunk lines such as have been built in the last forty years, some of them spanning the entire continent.

The British government never permits an opportunity for cultivating a healthy sentiment on the part of the general public in regard to naval matters to slip by unimproved. Maritime exhibitions are fostered at the principal seaports. Naval maneuvers are carried on along her whole coast. Launches and trials are made semi-public functions. All the traditions of the past glories of the naval and mercantile fleets of Britain are made part of the education of the youth, and the desire to increase the glory of future fleets is carefully instilled into the coming generation, until it has become a part of the national life. No matter what the programme may be for the increase of the British Navy or the advancement of the mercantile marine, the country responds heartily. If we felt the necessity for naval power as Britain feels it, nothing could prevent its realization. Every country to-day that aspires to a leading place among the nations feels the necessity for securing, no matter at what cost, a position on the sea commensurate with the position aspired to in the council of nations. The development of the great coast lines of America, the necessity of providing industrial opportunities for the population of the cities and states bordering on the ocean, are questions that are pressing now for a solution, and this pressure will increase until it commands attention.

No industry equals shipbuilding in the amount of work it provides for large numbers of men. The shipyard of which I was until lately manager, not a very large one when compared with the great yards in the centers of shipping interests, maintains, through its direct employment of between three and four thousand men, a population of at least fourteen thousand. Into no other product of man's skill does such a large proportion of the money expended go for wages. That is one reason why shipbuilding centers are so generally prosperous. The shipbuilder may fail to get rich personally, and generally does, but as long as he builds ships he never fails to scatter wealth all around. The pity is that so few of them succeed in holding on to a small portion for themselves. The shipbuilder's art, and the art of making wealth, are hardly ever found in the same individual. It has often been said of my own family that "they would rather build ships and remain poor, than do anything else and grow rich."

When the necessity of having our flag represented in the commerce of the world in proportion to the wealth of the country becomes a general sentiment among the people, obstructive laws will be swept away, and wise laws, to carry such sentiment into effect, enacted. Till then, those who have this great question on their hearts must work and wait, using every opportunity that presents itself to impress upon others the necessity that they see and feel to be fast coming upon this country to assert itself as a power that means to take a fair share in the ruling of the wave.

If, then, the time is fast approaching when the United States, in a commercial sense, must give an affirmative answer to the question of the necessity of being a great power on the sea, is it the same in regard to the same question in a naval sense? Our country has already answered this question in the affirmative. The civil war has served to show in what direction the naval architect must look for the warship of the future. This knowledge, however, was for the benefit of British and French naval establishments, and not for the country that had so dearly bought the experience. The government had greater and more pressing necessities to provide for than the reconstruction of a navy. The whole edifice of government had been shattered, and must be rebuilt almost from the very foundations. Among the many necessities of the time a modern navy was not by any means the most needed, so the Navy Department fell out of sight of the people; they had so many other things to look at that were nearer home. For about twenty years the people of the United States knew nothing about their navy, and did not appear to care whether there was a navy or not. During these years a revolution, based partly on what had been learned from this country's experiences, had taken place in the navies of the world. The warship, like the merchant ship, was being built of new materials, and a race was being run between steel protection and gun penetration. Modern machinery was increasing the speed for short distances, as well as the ability to run long distances. When at last the American people, about eighteen years ago, began to feel that a navy was a necessity, if we were to be secure at home or honored abroad, the Navy Department, or what was left of it, which was very little, had to begin what was practically a new business. What other nations had reached through twenty years of experiment must be mastered at once by the United States naval architect, for this people have never been tolerant in regard to mistakes, as we know to our cost. With the growth of experience in the British and European naval centers had grown up great plants for handling the raw material required, and skill in operating them, so that the result could be depended upon. With us, such plants were expected to be brought into existence and perfect operation without passing through the experimental stage, and the result be not only equal to the best produced hitherto, but better in every particular. How the engineers and naval architects of this country responded

to this sudden demand upon their abilities, both in design and execution, has been the admiration of naval experts the world over.

Eighteen years ago our naval architects and shipbuilders were twenty years behind those of Great Britain. To-day we are abreast of the most advanced practice in warship construction. The progress made toward providing this country with an effective, powerful, and in every way modern navy has been very satisfactory, and the Navy Department, with its splendid staff of naval architects and engineers, is quite able to meet the requirements of the future.

Thoughtful men sometimes wonder what we want with a navy when we have no merchant marine whose interests it is the duty of the navy to protect. It is a matter of universal knowledge, and I think almost universal regret, that our deep-sea shipping is practically driven from the ocean, more than 90 percent of our foreign commerce being carried in foreign ships flying foreign flags. In order that the United States may participate in ocean commerce to the extent to which her own imports and exports entitle her, there must be, first, a strong sentiment throughout the country in favor of carrying the products of our industry under our own flag to every country that cares to exchange products with us; second, wise national laws to foster and protect our merchant marine, making it possible for our shipbuilders to construct and equip ships and our shipowners to purchase and operate them; third, state and municipal laws, on the part of sea-girt states and maritime cities, encouraging shipbuilding and shipowning within their own borders. I have already spoken of the need of a general sentiment throughout our country in favor of a revival of the merchant marine. Now what has been done in regard to securing wise national legislation looking to the revival of American shipping for foreign commerce? The President in his annual message to Congress, December 7, 1903, said: "A majority of our people desire that steps be taken in the interests of American shipping so that we may once more resume our former position in the ocean carrying trade. But hitherto the differences of opinion as to the proper methods of reaching this end have been so wide that it has proved impossible to secure the adoption of any particular scheme. Having in view these facts, I recommend that the Congress direct the Secretary of the Navy, the Postmaster General, and the Secretary of Commerce and Labor, associated with such a representation from the Senate and House of Representatives as the Congress in its wisdom may designate, to serve as a commission for the purpose of investigating and reporting to Congress at its next session what legislation is desirable or necessary for the development of the American merchant marine and American commerce." In response to this earnest recommendation Congress passed the act of April 28, 1904, creating the Merchant Marine Commission, composed of five senators and five representatives. The mercantile interests of the country welcomed the investigation, and readily appeared before the commission to give testimony. The commission held meetings and took evidence in New York, Philadelphia, Baltimore, Boston, Galveston, New Orleans, Pensacola, Brunswick, Newport News, Chicago, Detroit, Cleveland, Milwaukee, Seattle, Tacoma, Portland, and San Francisco. The commission also held daily sessions in the city of Washington from November 22 to December 12, 1904, hearing evidence, sifting the printed testimony, and preparing the bill that is now pending. The testimony given before this commission, now published in three volumes, is a remarkable mass of evidence, with much difference in opinion as to methods and policies, but nowhere is there any difference as to the main principle of national recognition and encouragement of our hard-pressed ocean carrying trade. Of the hundreds of witnesses that appeared before the commission, a large proportion were men who have not a dollar's worth of actual interests in ships or shipbuilding, showing that the people are now really interested in the possible revival of our merchant marine. The report of the commission, largely explanatory of the bill introduced by them, should be carefully read by every one interested in the revival of our foreign commerce. The bill itself is a compromise measure; very few will find it entirely satisfactory in all its provisions; there are many conflicting interests that must be considered, and the result of the labor of the commission, as embodied in this bill, should receive the hearty support of all who desire to foster the upbuilding of our merchant marine.

Natural conditions, over which our shipowners and shipbuilders have no control, make the cost of building vessels in the United States much greater (from 30 to 40 percent at least) than the cost of building vessels in other countries. The cost of manning and victualling American-built ships is also much greater, probably not less than 30 percent, than it is in foreign ships. In addition to this there are other expenses in the management of vessels which are greater in the United States than they are in other countries, such as taxes, repairs, outfit, and equipment. Most of these higher costs are the outgrowth of conditions resulting from the policy of high protection that has obtained in the United States during practically the same period that American shipping engaged in the foreign trade has been declining.

The cost of materials entering into the construction and outfitting of American vessels is necessarily higher because of the conditions that obtain in other industries that are highly prosperous under the protection afforded by the tariff—industries employing precisely the same materials that are employed in shipbuilding and outfitting. The wages of the workmen employed at our shipyards are on the same high scale, due to the general standard of wages prevailing in similar industries, great, powerful, and profitable under a protective system that covers everything but the ship engaged in foreign trade. Let me give you a comparison I made in 1900, when visiting shipyards abroad, of the actual wages paid per week in the Union Iron Works shipyard, San Francisco, with the average weekly wages paid to the same class of workmen in twelve of the principal yards in Great Britain:*

	U. I. W.	BRITISH.
Drafting room: draftsmen	$19.44	$9.24
apprentices	6.30	3.10
Pattern shop: pattern makers	22.74	9.75
helpers	13.20	6.25
apprentices	6.07	3.02
Blacksmith shop: blacksmiths	20.28	9.84
helpers	13.20	6.62
apprentices	6.72	3.78
Machine shop: machinists	19.38	9.69
helpers	13.20	6.86
apprentices	5.58	3.05
Boiler shop: laying-out men	20.28	10.00
boiler makers	19.74	9.36
apprentices	7.08	3.22
Joiner shop: joiners	21.18	9.50
helpers	12.72	6.35
apprentices	7.08	3.22
Ship carpenters and calkers	22.14	9.88
helpers	13.20	6.22
apprentices	5.76	3.32
Ship fitters: fitters	20.10	9.50
helpers	12.60	6.52
apprentices	7.25	3.67
Riveters	21.50	9.88
rivet-heater boys	7.80	4.20
Drillers, chippers, and calkers	18.34	8.98
helpers	13.28	6.72
Coppersmiths	19.20	9.72
helpers	13.44	7.36
boys	7.20	3.86

While these conditions continue to exist it is futile to suggest, as has been done, that ships can be built in the United States as

*In only eleven of the thirty cases cited does the American wage fall below *double* the British; in only five cases is the excess less than 90 percent; in no case is it under 70 percent in excess.—The Editor.

cheaply as abroad. The mere fact that they are not built at all indicates that their cost renders them unprofitable in comparison with foreign vessels. Even if other nations did none of the things that they have so long done, for the encouragement and maintenance of their merchant shipping, the difference in cost of constructing, operating, etc., between American and foreign vessels, would suffice to make it unprofitable, and hence unattractive, to Americans either to invest in or to build ships for the foreign trade. But when we add to these undeniable advantages which foreign competitors possess over our own citizens, the ad vantage which they also possess through government assistance and regulation, then the reason why our American vessels carry but 9 percent of a foreign commerce valued at about $2,500,000,000 annually, and why foreign vessels carry over 90 percent of this commerce, receiving therefor freight charges closely approximating two hundred millions of dollars, are pretty well explained and set forth. These are the conditions that Congress must recognize and adequately meet through the adoption of effective legislation, before the problem of establishing an American merchant marine in the foreign trade, measurably equal to our foreign carrying needs, has been solved. I have faith in the ability of Congress to solve the problem of how best to revive and maintain the merchant marine in this country. The work done by the present commission has thrown much light on what was obscure in the problem, and the long-suffering shipbuilder and shipowner will yet see what he has so long looked for—business that if well done will bring satisfactory compensation.

Whatever expenditures the government may have to make in order to build up our merchant marine will be a good investment for the nation. We are spending on our new navy over $80,000,000 annually, and without a corresponding merchant fleet to depend on for service in time of need the war fleet's power may be very much weakened. During the Spanish war the United States was hard pressed for merchant steamers to carry men and materials; we had to buy freight ships at any price that was asked, and this war was a small thing for this great country; yet the lesson taught in this respect has passed unheeded. During the war between Japan and China the former had no merchant ships of her own to depend on; she had to hire or buy whatever she could get, but the experience was not lost. After the war she determined to have a merchant marine of her own, and set about bringing it into existence, the government helping the shipbuilder and shipowner to the extent necessary to effect the desired result. When the time came to try her strength against that of Russia, she had at least fifty large ocean steamers of her own, ready at once for the work, enabling her to strike a quick and decisive blow at the Russian, who was dreaming that it would take the Jap a long time to get ready. She had transports all ready to send with her army as soon as war was declared. Her investment in a merchant marine was a paying one. We will soon see a still further expansion of the merchant marine of Japan. No nation can be a great sea power without a great merchant marine, giving a reserve of both ships and men in time of need.

Besides the aid that must come from national legislation, I have always maintained that the sea-bordered states will be forced to apply state legislation to the upbuilding of their own shipping interests. The state can foster shipping just as effectively as the nation, as the benefits to be derived from large shipping interests will center in the shipowning and shipbuilding states. For instance, to every ship built and owned in the state in which she is enrolled, the harbors of the state ought to be free, and all shipping property, when engaged in inter-state or foreign commerce, should be relieved of all state or municipal taxes. Some states have done this, to a limited extent, and these states own whatever ocean trade this country possesses to-day. The eyes of the people of this country are being opened to the importance of naval power, both in a military and commercial sense; also to the future position we are destined to occupy among the great nations of the world. One thing is certain, we have entered on a course that is to lead us, if not into deep water, at least on to deep water, and on deep water we will be much safer in our own ships.

Progress of Naval Vessels.

The Bureau of Construction and Repair, Navy Department, report under date of October 10, 1905, the following percentage of completion of vessels building for the United States Navy:

				Sept. 1	Oct. 1.
BATTLESHIPS.					
Virginia	19	knots.	Newport News Co.	92.89	94.24
Nebraska	19	"	Moran Brothers Co.	79 58	81.
Georgia	19	"	Bath Iron Works	86.44	87.44
New Jersey	19	"	Fore River Shipbuilding Co.	89.3	90.1
Rhode Island	19	"	Fore River Shipbuilding Co.	93.	93.7
Connecticut	18	"	Navy Yard, New York, N. Y.	86.15	89.39
Louisiana	18	"	Newport News Co.	86.4	87.73
Vermont	18	"	Fore River Shipbuilding Co.	61.4	63.8
Kansas	18	"	New York Shipbuilding Co.	60.1	62.7
Minnesota	18	"	Newport News Co.	71.16	73.86
Mississippi	17	"	Wm. Cramp and Sons.	38.71	40.87
Idaho	17	"	Wm. Cramp and Sons.	33.66	36.22
New Hampshire	18	"	New York Shipbuilding Co.	18.2	20.4
ARMORED CRUISERS.					
California	22	knots.	Union Iron Works	81.8	82.9
South Dakota	22	"	Union Iron Works	80.6	81.9
Tennessee	22	"	William Cramp and Sons.	84.32	86.08
Washington	22	"	New York Shipbuilding Co.	83.9	85.8
North Carolina	22	"	Newport News Co	14.96	19.2
Montana	22	"	Newport News Co	13.04	16.81
SEMI-ARMORED CRUISERS.					
St. Louis	22	knots.	Neafie and Levy Co.	75.7	79.69
Milwaukee	22	"	Union Iron Works	80.6	82.
Charleston	22	"	Newport News Co.	99.7	99.8
SCOUT CRUISERS.					
Chester	24	knots.	Bath Iron Works	0.	6.11
Birmingham	24	"	Fore River Shipbuilding Co.	4.7	9.3
Salem	24	"	Fore River Shipbuilding Co.	4 3	8.2
TRAINING SHIPS.					
Cumberland	Sails		Navy Yard, Boston	95.	95.
Intrepid	"		Navy Yard, Mare Island	97.5	97.5
TORPEDO BOATS.					
Goldsborough	30	knots.	Wolff and Zwicker	99.	99.
O'Brien	26	"	Lewis Nixon	99.	99.
SUBMARINE TORPEDO BOATS.					
Submarine No. 9			Fore River Shipbuilding Co.	17.6	25.4
" " 10			Fore River Shipbuilding Co	16.5	21.1
" " 11			Fore River Shipbuilding Co	16.5	23.6
" " 12			Fore River Shipbuilding Co	16.5	23.1

The Generating Sets of the Connecticut.

In the electric-light plants of the United States Navy the ordinary commercial conditions are departed from greatly. While it is the usual custom when furnishing an engine of a given power to guarantee that it will carry a certain overload for a certain time, the Bureau of Equipment of the Navy demands that the overload carried shall be 33⅓ percent above the rated capacity of the engine and generator, as of course these must go together.

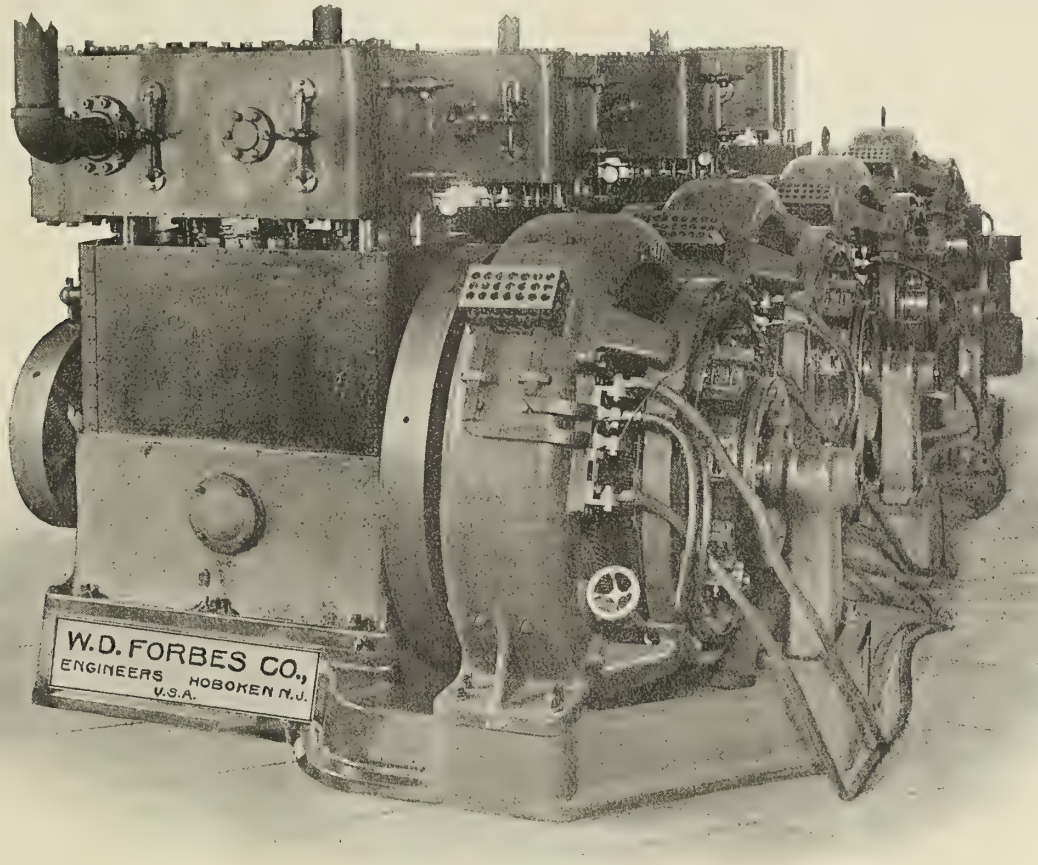
For evident reasons a very condensed plant is to be considered, and weight is a matter of great importance. Coupled with these requirements is first-class governing, and the water consumption must be brought down on certain sizes to very low figures. The steam pressure is varied by dropping 20 percent below normal and by being carried 20 percent above. These conditions demand a special engine which can hardly be called commercial. In other words, the bureau has gone very closely to the limit of possibility, if it has not in some sizes of sets gone past it.

Other demands are also made, as for instance, in a compound engine the stroke must not exceed the diameter of the high-pressure cylinder. This is done with a view to preventing the oil which may be splashed on the piston rod from being carried into the cylinder and over to the condenser, and thence to the boiler, where it would do damage.

The oiling system is forced by means of a pump, but the manufacturers are not restricted as to what style of force system shall be employed. There are two forcing systems, one wherein the oil is passed from one bearing on to a second, and then on to a third, and even a fourth at times; the second, where the forced oil

travels directly to each bearing independently. The first system is open to the serious objection that if the first bearing happens to be loose the oil does not reach the second bearing. In the second system this objection is entirely overcome.

The engines consist of compound units with cylinders measuring 10 and 20 inches respectively in diameter, and a stroke of 10 inches, and operate as above at a speed of 350 revolutions per minute. The steam pipe has a diameter of 3 inches and exhaust

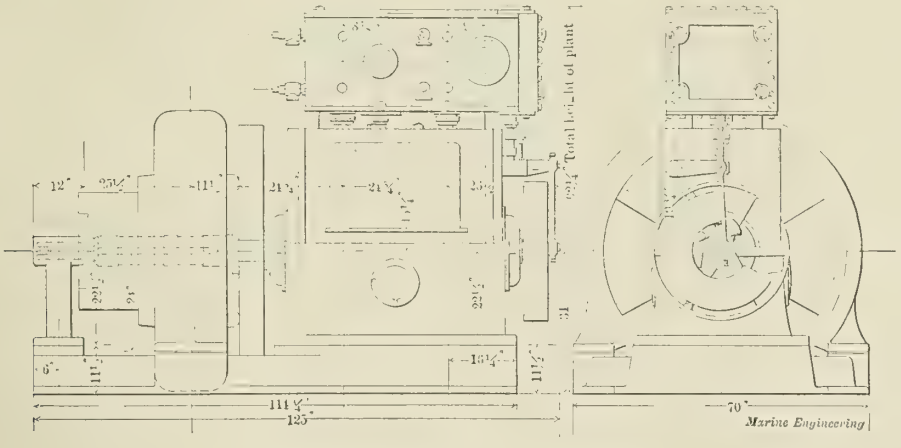


A GROUP OF FOUR GENERATING SETS FOR THE CONNECTICUT.

The Crocker-Wheeler Company, on obtaining the contract for supplying the *Connecticut* with her electric-light plants, made selection of the Forbes engine, which is built by the W. D. Forbes Company, in Hoboken, as an engine likely to meet the above requirements. In every respect the results of the tests already made have been highly satisfactory, and the engines have met all requirements. In these engines the Right governor is used, and the revolutions (350) have never varied more than one revolution either up or down, when throwing off the overload or throwing it on. The generator also fills all the demands noted; and the battleship *Connecticut* will be equipped with the largest electric installation of any ship in our navy.

pipe of 6 inches. The drawing shown herewith indicates that the entire length of each set over all is 10 feet 5 inches, while the length of the foundation is 9 feet 6¾ inches. The extreme width is 5 feet 10 inches, and the total height from bottom of foundation to top of cylinder-head studs is 7 feet 8¼ inches.

There are eight of these sets to be installed on the *Connecticut*,



THE GENERAL LAYOUT OF ONE OF THE SETS.

of which four are shown in the accompanying photograph. The total weight of each set without throttle and exhaust valves is 23,270 pounds, which figures out at 232.7 pounds per kilowatt normal output.

The generators of these sets are of the multipolar type, having eight poles of cast steel bolted to the frame. The frame is of

cast iron with internally-projecting flanges, which insure ample stiffness and give a finished and pleasing appearance to the machine. The frame is split horizontally, the halves being accurately lined by dowel pins and held together by bolts.

The field winding is compound, with the shunt and series coils separate, with the very efficient cooling surface which is necessary to insure the cool running demanded of such sets.

The commutator spider is mounted on an extension of the armature spider in order to have it independent of the shaft. The commutator bars are of the highest grade of hard drawn copper, designed to give ample wearing depth. The surface of the commutator is very liberal and the brush density low. The core, winding, and commutator are thoroughly ventilated, which insures a uniformly low temperature throughout.

The sets possess very satisfactory commutation and compounding characteristics and in their mechanical construction and electrical behavior they come well within the government requirements. Each machine is connected to the engine by flange coupling and the two mounted on a common sub-base.

The Voyage of the Steamship Dakota from New York to Seattle.

Particulars relative to the maiden voyage of the Great Northern steamship *Dakota,** built by the Eastern Shipbuilding Company, New London, Conn., will, no doubt, be of interest to maritime and engineering circles, on account of the size of the vessel, design, installation of water-tube boilers, and the length of voyage.

Only twelve of the sixteen boilers were used at the same time during the whole run, and the same engineering staff that had charge of her engine and boiler rooms during the speed-trial run off the coast of Virginia, in the month of April last, took her around to Seattle, Wash., and consisted of the following men: one chief engineer, one first assistant engineer, two second assistant engineers, two third assistant engineers, two fourth assistant engineers, three junior engineers, three electricians, two refrigerating engineers, one deck engineer, fifteen oilers, nine water tenders, thirty-six firemen, thirty coal passers, a total of 107 officers and men.

The start was made from the pier in New York at 1.30 P.M., April 28, 1905, and Sandy Hook passed at 3.40 P.M. The pilot was discharged at 4.30 P.M., and full speed ahead was commenced at 4.34 P.M. of the same day. The draft on leaving New York was 32 feet 2 inches forward, and 32 feet 4 inches aft, equal to a displacement of about 31,000 tons, with 5,044 tons of Pocahontas coal in the bunkers.

The electric steering gear was used during the whole run and has been pronounced by Capt. Emil Francke, the commander of the vessel, to have given entire satisfaction, and all connected with the vessel have words of praise for her seagoing qualities, and call the *Dakota* the best sea vessel they have ever been on.

The *Dakota* arrived at Coronel, Chile, at 7.05 A.M., May 28, 1905; the total distance steamed in 29 days 10 hours and 53 minutes was 8,778.1 nautical miles; average speed 12.32 knots; and the coal consumed during the voyage was 4,060 tons, making the coal remaining in bunkers 984 tons. The fresh water used during the run for boiler feed make-up was of an average of 32 tons per 24 hours, and total oil used for lubricating purposes was 1,500 gallons. The draft on arrival at Coronel was 27 feet 2 inches forward and 29 feet 4 inches aft. The induced-draft fans had been running continuously on the whole voyage, without giving the least trouble, and the mechanical stokers had done the same.

At Coronel, 3,163 tons of Schwager coal was put in her bunkers, and, while coaling, the engineers examined and adjusted the parts of machinery and boilers needing attention. At 12.40 P.M., on Saturday, June 3, the ship left Coronel for San Francisco. The pilot was discharged at 1.00 P.M., and full speed ahead commenced at 1.04 P.M. The draft on leaving Coronel was 29 feet 5 inches forward and 31 feet 6 inches aft, corresponding to a displacement of about 29,300 tons. It was soon discovered that the Chilean coal did not work very well in connection with the mechanical stokers, and considerable trouble was experienced with same.

Stopped for pilot at San Francisco at 11.00 A.M., June 20, and anchored at 12.25 P.M. The distance steamed in 17 days was 5,286.3 nautical miles; average speed, 12.92 knots; and the coal consumed during the voyage was 2,797 tons. The fresh water used for boiler feed make-up per 24 hours was about the same as on the run from New York to Coronel. The vessel was placed at dock in the afternoon of the day of arrival, and the discharging of cargo, consisting principally of steel rails, commenced the following day. In handling the cargo the electric deck winches gave excellent satisfaction.

While at San Francisco opportunity was taken to examine the different parts of the main engines and to make adjustments. Some of the main cylinders and valves were also looked at, and all found to be working up nicely to a good smooth surface.

At 4.40 P.M., June 24, the ship left San Francisco for Seattle, and full speed ahead was commenced at 6.01 P.M. of the same day. The *Dakota* arrived at Seattle about noon on June 27; the distance steamed in 2 days 18 hours and 11 minutes was 815 nautical miles; average speed 12.15 knots; and the coal consumed during this run was 510 tons.

On arrival at Seattle the mechanical stokers were entirely out of commission; they will be repaired at Seattle and given further trial with the coal they take on board at said port. Everything else was in first-class shape, and the ship could have started for sea again by the time she was coaled.

From the foregoing statement it will be seen that the *Dakota's* actual steaming time from New York to Seattle, a distance of 14,879.4 nautical miles, was 49 days, 5 hours, and 4 minutes, and during these long runs 7,367 tons of coal were consumed in her boilers.

The boilers throughout the whole trip worked excellently; small defects developed, principally with the brickwork in furnaces; but, as only twelve out of the sixteen boilers were in use at the same time, one of these spare boilers was lighted and cut in when necessary to clear and rectify any defects on any of the other boilers. This method was extensively used when the mechanical stoker boilers commenced to give trouble.

The maximum speed of the *Dakota* was reached on June 12, when she steamed 350.3 knots in 24 hours, consuming about 160 tons of coal. Average speed, 14.5 knots.

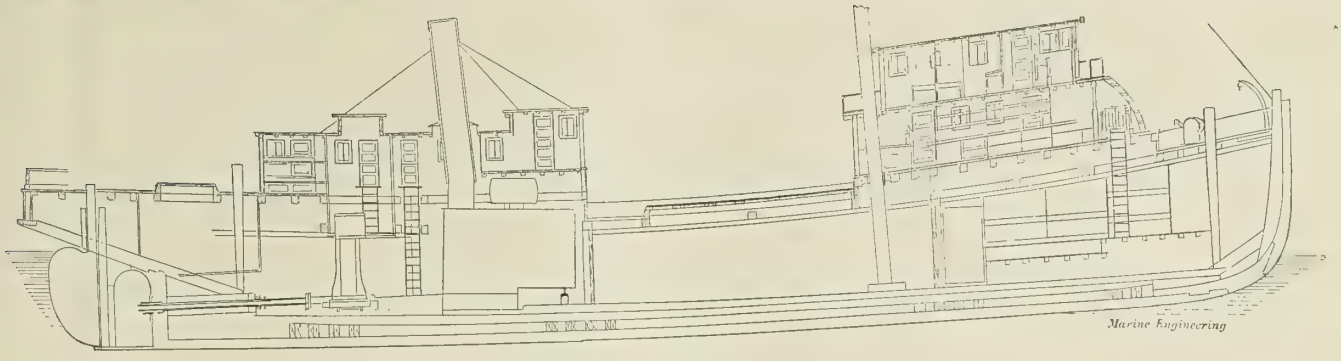
Much has been said and written about the battleship *Oregon's* run in 1898 from Puget Sound, Wash., to Jupiter Inlet, Fla., a distance of 14,510.9 nautical miles, which she made in 54 days, 3 hours, and 51 minutes, actual steaming time, and consuming 4,009.38 tons of coal during the whole run. The *Oregon's* greatest displacement during her long voyage was 11,857 tons, being only about one-third of the *Dakota's* displacement.

The Fishing Steamer James M. Gifford.

Built for the Fisheries Company, of New York, the *Gifford* has a length of 129 feet over all, a molded beam of 19 feet 3 inches, and a depth of 9 feet 6 inches. The framework of the hull, including keel, stem, stern post, and frames, is of white oak. Outside planking, ceiling, clamps, shelf, keels, deck beams, and deck are of yellow pine, while deckhouse and hatches are of white pine. The *Gifford* has a Trout propeller actuated by a simple engine with cylinder 20 by 20 inches, supplied with steam by a boiler 8 feet in diameter and 13 feet long. The engine is operated condensing, the surface condenser being from the works of Williamson Brothers, of Philadelphia.

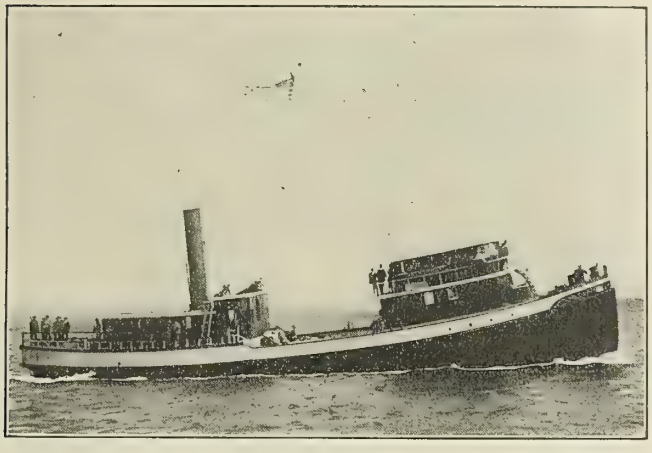
The *Gifford* was built by the Greenport Basin and Construction Company, of Greenport, N. Y., under contract signed in January last, was launched April 15, and has recently been delivered.

*For description of vessel and machinery, see Marine Engineering, June, 1905, page 248; and July, 1905, page 290.



INBOARD PROFILE OF FISHING STEAMER JAMES M. GIFFORD.

The boat was launched just thirty-nine days after the keel was laid. The trial trip occurred May 29, and the steamer was delivered to her owners the following day. She is designed to carry from 1,100 to 1,200 barrels of fish. We present a photograph of the steamer, together with an inboard profile, showing the general arrangement to be very similar to that of the steam trawlers operating in the North Sea, and illustrated on page 303 of MARINE ENGINEERING for July.



THE GIFFORD UNDER WAY.

TABLE I.

Cylinder Sizes with Ratios.			H. P. to M. P. = 1:2.8. H. P. to L. P. = 1:7.		
H. P.	M. P.	L. P.	H. P.	M. P.	L. P.
9	15	24	9½	15½	25
10	16½	26½	10½	17⅜	28
11	18	29	11⅛	19	30⅛
12	19⅛	31½	12⅛	20½	33
13	21⅛	34½	13½	22	35½
14	23	37	14½	24	38½
15	24½	39⅛	15½	25½	41
16	26½	42⅛	16½	27	43⅛
17	28	45	17⅛	29	48⅛
18	29	47½	18½	30½	49
19	31½	50	19½	32	51½
20	33	53	20½	34	54½
21	34½	55½	21½	35½	57
22	36	58	22½	37	59½
23	38	61	23½	38½	62
24	39½	63½	24½	40½	65
25	41	66	25½	42	67½
26	43	69	26½	43½	70
27	44½	71⅛	27⅛	45½	73
28	46	74	28⅛	47	75½
29	47⅛	76½	29½	48½	78
30	49⅛	79½	30½	50	80½
31	51	82	31½	52	83½
32	52½	84½	32½	53½	86
33	54½	87⅛	33½	55	88½
34	56	90	34½	57	91½
35	57½	92½	35½	58½	94
36	59	95	36½	60	96½
37	61	98	37⅛	61½	99
38	62½	100½	38⅛	63½	102
39	64	103	39⅛	65	104½
40	65½	105½	40½	66½	107

USEFUL DATA OF SCOTCH MARINE ENGINEERING PRACTICE.

BY H. WILKES.

In marine engineering work the preponderance of experience has been on the other side of the water. The engineering world has grown beyond and little recognizes national boundaries, however, so that reciprocity in data and experience is now well-nigh universal. Every broad-minded engineer recognizes that the greater part of the valuable information in his private data book comes from the work of others, and in a measure should be available to his co-workers. The accompanying tables and diagrams are taken from the leaves of the writer's pocket-book, all the figures being based upon engines, boilers, and accessories actually constructed by Scotch and English marine-engine builders.

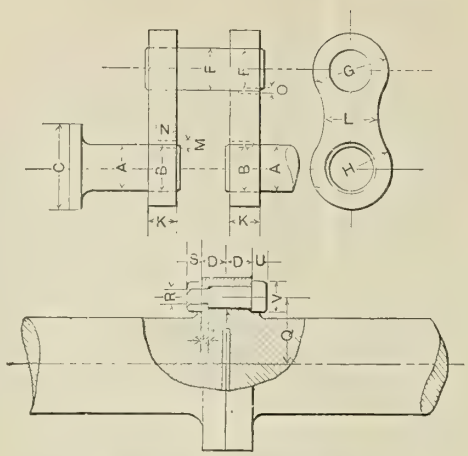
Table I gives the relative sizes of high, low, and intermediate cylinders of marine engines; and Table II general proportions

TABLE II.—I. H. P. OF BOILERS.

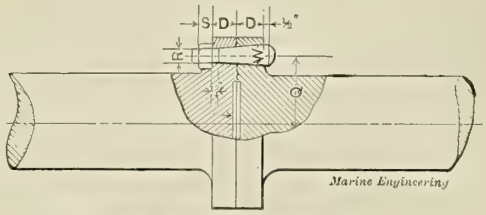
I. H. P. Per Cubic Foot.			Size of Boilers.			I. H. P. Per Cubic Foot.			Size of Boilers.		
.4	.45	.5	Diam.	Length	Volume.	.4	.45	.5	Diam.	Length.	Volume.
160	180	200	8′ 0″ 8′ 3″	7′ 11½″ 7′ 6″	400	600	675	750	14′ 3″ 14′ 6″	9′ 5″ 9′ 0″	1,500
200	225	250	8′ 9″ 9′ 0″	8′ 4″ 7′ 10½″	500	640	720	800	14′ 6″ 14′ 9″	9′ 7½″ 9′ 4½″	1,600
240	270	300	9′ 6″ 9′ 9″	8′ 6″ 8′ 0″	600	680	765	850	14′ 9″ 15′ 0″	9′ 11½″ 9′ 7¼″	1,700
280	315	350	10′ 3″ 10′ 6″	8′ 5″ 8′ 0″	700	720	810	900	15′ 0″ 15′ 3″	10′ 2¼″ 10′ 0″	1,800
320	360	400	11′ 0″ 11′ 3″	8′ 5″ 8′ 0″	800	760	855	950	15′ 3″ 15′ 6″	10′ 5″ 10′ 0″	1 900
360	405	450	11′ 6″ 11′ 9″	8′ 8″ 8′ 4″	900	800	900	1.000	15′ 9″ 16′ 0″	10′ 3″ 10′ 0″	2,000
400	450	500	12′ 0″ 12′ 3″	8′ 10½″ 8′ 6″	1,000	840	945	1.050	16′ 0″ 16′ 3″	10′ 5½″ 10′ 1⅛″	2,100
440	495	550	12′ 6″ 12′ 9″	9′ 0″ 8′ 7½″	1,100	880	990	1,100	16′ 3″ 16′ 6″	10′ 7½″ 10′ 3″	2,200
480	540	600	13′ 0″ 13′ 3″	9′ 0″ 8′ 9″	1,200	920	1.035	1,150	16′ 6″ 16′ 9″	10′ 9″ 10′ 5¼″	2,300
520	585	650	13′ 6″ 13′ 9″	9′ 1″ 8′ 9½″	1,300	960	1.080	1.200	16′ 9″ 17′ 0″	10′ 10⅜″ 10′ 7″	2,400
560	630	700	13′ 9″ 14′ 0″	9′ 6″ 9′ 1″	1,400	1,000	1,125	1,250	17′ 0″ 17′ 3″	11′ 0″ 10′ 8⅜″	2,500

TABLE IV.

	I. H. P. per Ton of Boiler.	Number of Engines.	Total Grate Surface. Sq. Ft.	Total Heating Surface. Sq. Ft.	Ratio of H. S. to G. S.	Boiler Pressure.	I. H. P.	I. H. P. per Square Foot of Grate Surface	I. H. P. per Sq. Ft. of Heating Surface.	Grate Surface per I. H. P.	Heating Surface per I. H. P.	Number, Size of Boilers, and Length.	Number and Size of Furnaces.	Length of Grate Bar.	Total Number of Tubes, Diameter, and Length.	Thickness of Tubes. Common (B.W.G.), Stay (Inches). C. S.	Area through Tubes. Ft.	Ratio of G. S. to Tube Area.	Diameter and Height of Funnel.	Ratio of G. S. to Funnel Area.	Steam Space in Cubic Feet.	Cubic Feet of Boiler to One Sq. Ft. of H. S.	Cubic Feet of Do. per I. H. P.	Net Weight of Boiler. Tons	Duration of I. H. P.	Weight of Water. Tons	H. S. to One Cubic Foot of Boiler.	Weight of Water per Cub. Ft. of Boiler. Lbs.	I. H. P. per Cubic Foot of Boiler.
	22.14	138	117	4 174	35.7	160	1,583	13.53	.1792	.0739	2.635	2 D.E. 11′ 6″ ×15′ 6″	8 S.B. 3′ 3″	4′ 6″	752×3″ ×6′ 0″	8×$\frac{5}{16}$″	27.5	4.26	6′ 6″×54″	0″ 3.53	808	.510	.771	71.0	Mean of 2 runs on mile	37.5	1.297	26.0	.492
	21.77	139	24.75	762	30.8	160	1,583	13.90	.3514	.0917	2.822	1 S.F. 9′ 6″ · 8′ 3″	2 S.B. 2′ 9″	4′ 6″	122 3¼″ 5′ 10½″	10 · 1″	5.64	4.39	2′ 9″ · 26′	2″ 4.17	130	.481	.769	142.5	Mean of 2 runs on mile	7.85	1.393	30.05	.461
	19.82	140	117	2 879	24.6	158.5	1,328	11.35	.4613	.0880	2.168	2 S.F. 13′ 0″ ×11′ 6″	6 S.B. 3′ 3″	6′ 0″	800×3¼″×7′ 6″	7×$\frac{5}{16}$″	17.7	6.61	6″×45″	0″ 4 93	686	.512	.599	135	Mean of runs on 87 knots	38.0	0.943	27.77 49.1	.435
	20.0	143	129 5	4 210	12.5	160	1,460	11.28	.3468	.0880	2.883	2 D.E. 12′ 0″ ×15′ 6″	8 S.B. 3′ 3″	5′ 0″	696×3¼″×6′ 1″	8×$\frac{5}{16}$″	30.0	4.33	0″×62′	0″ 3.37	814	.558	.532	157.5	Mean on mile	42.0	1.202	46.65	.446
	21.77	141	193	5,142	16.6	160	2,046	10.60	.3979	.0943	2.513	2 D.E. 13′ 6″ · 10′ 0″	12 S.B. 3′ 2″	5′ 1″	728 3½″ · 6′ 6″	8 · $\frac{5}{16}$″	36.0	5.36	6″ · 58′	10″ 4 37	1,168	.512	.891	150	Mean between lights	57.0	1.123	46.0 28.1	.446
	21.13	144	220.5	6 170	28.8	150	2,539	11.02	.3939	.0908	2.539	2 D.F. 14′ 3″ ×18′ 0″	12 S.B. 3′ 6″	5′ 3″	808×3¼″×7′ 0″	7×$\frac{5}{16}$″	41.0	5.38	8′ 0″×60′	0″ 4 39	1,374	.565	.930	150	Mean of 2 runs on mile	67.0	1.075	45.0 27.4	.424
	21.3	147	156	4,800	30.8	160	1,811	11.61	.3773	.0861	2.650	2 D.E. 13′ 0″ ×16′ 0″	8 S.B. 3′ 10½″	5′ 0″	768×3¼″×6′ 4″	8×$\frac{5}{16}$″	33.0	4.73	7′ 3″×68′	6″ 3.78	928	.512	.885	144	Mean between lights. Power not taken out of engines bet. lights	85.0	1.175	45.0 24.5	.426
	21.92 23.86	148	255	7.755	30.5	160	2,700	10.74 15.29	.3503 .4230	.0931 .0953	2.830 2.361	2 D.E. 15′ 3″ ×17′ 0″	12 S.B. 3′ 6⅝″	6′ 0″	1,192×3¼″×6′ 9″	8×$\frac{3}{8}$″	51.0	5.00	9′ 0″×70′	0″ 4.01	1.730	.631	.800	160	Mean on mile between lights	68.0	1.249	45.1 25.6	.441 .513
	22.45	150	212	7.661	36.1	160	3,053	14.40	.3985	.0694	2.509	2 D.E. 14′ 9″ ×18′ 6″	12 D.R. 3′ 3¼″	5′ 3″	1,160×3¼″×6′ 6⅜″	7×$\frac{7}{16}$–$\frac{3}{8}$″	48.3	4.39	8′ 3″×80′	0″ 3.97	1.666	.546	.825	156	Mean between lights	72.5	1.212	48.2 28.5	.484
	22.85	151	140	4 516	32.2	163	1,828	13.06	.4048	.0765	2.470	2 D.F. 12′ 6″ ×16′ 0″	8 S.B. 3′ 4″	5′ 3″	712×3¼″×6′ 5″	8×$\frac{1}{4}$″	30.5	4.59	7′ 0″×70′	6″ 3 64	1,000	.547	.869	155.5	Mean between lights	80.0	1.153	45.6 26.0	.466
	20.74	152	90	2,747	30.5	160	1,120	12.4	.4077	.0804	2.453	2 S.E. 12′ 9″ × 9′ 10¾″	6 S.B. 3′ 0″	5′ 0″	368×3¼″×6′ 6″	8×$\frac{1}{4}$″	19.0	4.74	5′ 0″×38′	0″ 4.58	594	.510	.915	54.0	Mean of run on mile	29.0	1.093	48.4 27.4	.446
	19.6	153	235	6,338	27.0	175	2 450	10.43	.3866	.0959	2.587	2 D.F. 14′ 0″ ×18′ 0″	12 S.B. 3′ 5″	5′ 9″	808×3¼″×7′ 3″	7×$\frac{7}{16}$–$\frac{3}{8}$″	39.6	5.93	8′ 4″×71′	6″ 4.31	1.352	.551	.874	125.0	Very bad coal	67.5	1.144	50.5 27.6	.442
H. P. D.	21.63	C. of O.	154	6,438	41.8	160	3 200	20.78	.4570	.0481	2.012	2 S.E. 16′ 3¼″×12′ 0″	8 S.B. 3′ 6¾″	5′ 6″	1,028×2¼″×8′ 0″	8×$\frac{1}{4}$″	25.75	6.00	9′ 0″×65′	0″ 2.43	1,116	.349	.773	108.0	About one hour trial	62.5	1.295	48.6 27.6	.404
N. D.	22.22	C. of O.	154	6,438	41.8	150	2 400	15.58	.3728	.0642	2.682	2 S.E. 16′ 3¼″×12′ 0″	8 S.B. 3′ 6¾″	5′ 6″	1,028×2¼″×8′ 0″	8×$\frac{1}{4}$″	25.75	6.00	9′ 0″×65′	0″ 2.43	1,115	.465	.771	108.0	About one hour trial	62.5	1.295	48.6 27.2	.448
	24.0		235	6 338	27.	180	3 000	12.77	.4733	.0783	2.113	2 D.E. 14′ 0″ ×18′ 0″	12 S.B. 3′ 5″	5′ 9″	808×3¼″×7′ 3″	7×$\frac{7}{16}$–$\frac{3}{8}$″	39.6	5.93	8′ 4″×71′	6″ 4.31	1.352	.450	.874	125.0	Mean between lights. Mean 6 runs between lights	67.0	1.144	50.4 26.7	.541
	17.26		74.75	2,266	30.3	165 150	850	11.3	.3751	.0882	2.666	1 S.E. 15′ 5″ ×11′ 6″	4 3′ 3″	5′ 9″	244×3¼″×7′ 9″	7×$\frac{3}{8}$″	14.1	5.37	4′ 3″×43′	0″ 4.24	556	.654	.957	49.0	Mean 2 runs on mile	26.0	1.045	50.9 26.7	.391
	28.0		74.75	2 266	30.3	160	984	13.2	.4342	.0761	2.303	1 S.E. 15′ 5″ ×11′ 6″	4 3′ 3″	5′ 9″	244×3¼″×7′ 9″	7×$\frac{3}{8}$″	14.1	5.37	4′ 3″×43′	0″ 4.24	556	.565	.957	49.0	Mean 2 runs on mile	26.0	1.045	50.9 26.0	.453
	28.1		56	1 616	28.85	110 93.5	422	7.54	.261	.133	3.83	1 S.E. 13′ 0″ ×10′ 3″	3 S.B. 3′ 3″	5′ 9″	246×3″ ×6′ 10½″	7×$\frac{3}{8}$″	9.3	6.02	3′ 10″×35′	6″ 4.86	340	.866	.842	21.0	Between light	15.8	1.19	26.0	.3103
	27.24		56	1,616	28.85	110 97½	572	10.21	.354	.0898	2.83	1 S.E. 13′ 0″ ×10′ 3″	3 S.B. 3′ 3″	5′ 9″	246×3″ ×6′ 10½″	10×$\frac{3}{8}$″	9.3	6.02	3′ 10″×33′	6″ 4.86	340	.594	.842	21.0	Mean on mile	15.8	1.19	34.58 25.9	.421
	25.5		82.5	2 991	36.2	160	1 371	16.61	.458	.060	2.181	1 S.E. 17′ 3″ · 10′ 7″	4 A. 3′ 9″	5′ 6″	434 3¼″ · 6′ 9″	8 · $\frac{5}{16}$–$\frac{3}{8}$″	19.08	4.32	6′ 6″×53′	0″ 3.97	486	.354	.827	53.3	Mean on mile	28.6	1.21	48.68	.554
	21.4		82.5	2 991	36.2	160	1 350	13.93	.384	.072	2.6	1 S.E. 17′ 3″ ×10′ 7″	4 A. 3′ 9″	5′ 6″	434×3¼″×6′ 9″	8×$\frac{5}{16}$–$\frac{3}{8}$″	19.08	4.32	5′ 6″×53′	0″ 3.97	486	.422	.827	53.3	Between lights mean	28.6	1.21	48.68	.465



Bolts with $\frac{3}{16}$ per foot Taper
Parallel Bolts shown as above Dia. =T



Bolts with ¾″ per foot Taper

DETAILS OF CRANK SHAFTS AND COUPLINGS.

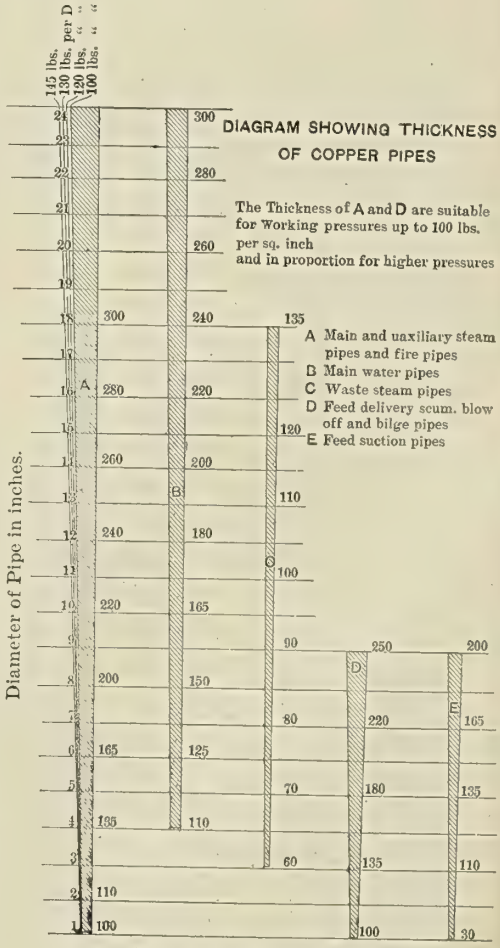


DIAGRAM SHOWING THICKNESS OF COPPER PIPES
The Thickness of A and D are suitable for Working pressures up to 100 lbs. per sq. inch
and in proportion for higher pressures
A Main and uaxiliary steam pipes and fire pipes
B Main water pipes
C Waste steam pipes
D Feed delivery scum. blow off and bilge pipes
E Feed suction pipes
145 lbs.
130 lbs. per D
120 lbs. " "
100 lbs. " "
Diameter of Pipe in inches.
The approximate thickness by Whitworths Gage is shown by figures along side
Marine Engineering

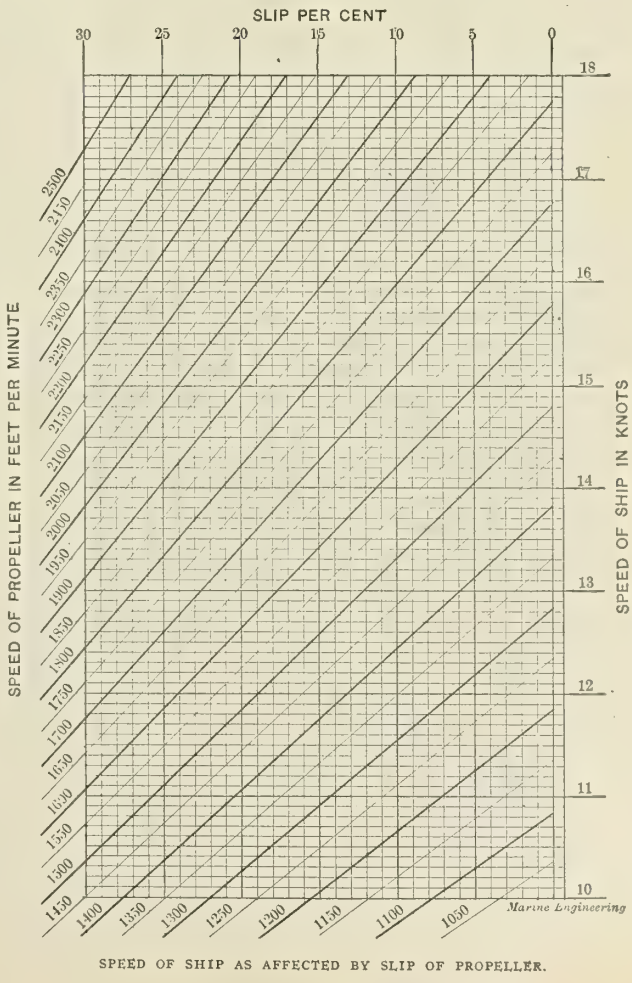
DIAGRAM SHOWING SCOTCH PRACTICE IN DESIGNING PIPE LINES.

TABLE III.

Number of Engines.	Cylinders. Size.	Cylinders. Ratio. L. P. to H. P.	Ratio. M. P. to H. P.	Ratio. L. P. to M. P.	N. H. P.	I. H. P.	Boiler Pressure.	Trial. Steam.	Trial. Vac.	Revolutions per Minute.	Piston Speed.	M. E. P.	Calculated Mean Pressure.	Ratio C. M. P.	Number of Expansions.	Steam Cut Off in H. P	Steam Cut Off in M. P.	Steam Cut Off in L. P.	Mean Pressure in Cylinders. H. P	Mean Pressure in Cylinders. M. P.	Mean Pressure in Cylinders. L. P.	I. H. P. in Cylinders. H. P.	I. H. P. in Cylinders. M. P.	I. H. P. in Cylinders. L. P.	Receiver Pressure. M. P.	Receiver Pressure. L. P.	Weight of Engine, Net.	Total Weight in Boiler Room.	Total Weight in Engine Room.	Total Weight in Tunnel.	Total Weight of Spare Gear and Stores.	Total Weight of Donkey Boiler, Winches, Etc.	Total Weight of all Machinery.	I. H. P. per Ton of Engine, Net.	I. H. P. per Ton of All in Engine Room.	I. H. P. per Ton of All in Boiler Room.	I. H. P. per Ton of All Machinery, Excluding Winches.
																											Tons	Tons	Tons	Tons	Tons	Tons	Tons				
138	24″ -40″-61″×3′ 9″	6.46	2.78	2.32	246	1,583	160	160	26	69.4	520.5	34.34	55.26	.621	10 65	27.31	32.12	31.62	87.7	26 2	9.52	625.7	519.3	205.7	45.5	5	109	142	129	35.6	14.25	28	347	14.52	12.3	11.27	4.95
139	10½″-16″-25″×1′ 9″	6.783	2.22	3.06	30	268	150	144	26	159	550.5	25.86	46.5	.556	11.87	12	11.56	11.37	71.32	10 11	9.79	109	54	462.4	41.5	13	11.5	25.3	12	2.5	0.82	....	40.3	23.3	22.3	10 6	6.64
140	24″ -35″-58″×3′ 6″	5.84	2.508	2.33	210	1,328	140	135	27	82.65	578.5	28.67	.....	....	.....	Ab't	Ab't	Ab't	51.99	23 26	9.42	704.2	687.2	655.2	453.5	46	7	93	107	26	1.15	9 5	276.7	14.28	12 4	10	4.97
141	25″ -41″-68″×4′ 0″	7.39	2.69	2 75	300	2 046	160	157.5	27¾	79	632	29.41	55 68	.528	10.32	34⅝	33⅜	31.62	74.9	27 18	9.42	704.2	687.2	655.2	55	8.25	107.3	189	128.5	16.5	6.2	38.5	378.7	16.9	10.8	6
142	28″ -44″-74″×4′ 3″	6.99	2.47	2 83	387	2,339	150	150	27½	74	629	28.41	55.89	.508	9.63	37.6	37.6	37.6	.....	.....	.....	925	792	613	....	2.5	150 7	235	181 2	50	24.7	34 6	525 5	15.45	12.85	10	4.74
143	24″ -38″-63″×3′ 9″	6.89	2.506	2.748	241	1,460	160	158.5	26⅝	71 5	536.5	28.82	52.7	.547	11 27	32	32 2	32	75.37	25.77	9.57	1,044	1,231	926	431	41	6.5	108	170	42.3	2.85	28.6	378.7	13.52	11.63	8.6	4.17
144	28″ -44″-74″×4′ 3″	5 99	2.47	2.75	387	2,433	150	150	26¼	68.5	532.25	32.06	55.89	.573	9.63	37	37.5	37.6	85 3	31.96	8.78	558	857	649	42.5	7	148 1	236 8	51.2 Wheels	36 1	24.25	531.9	16 44	13 3	10.28	4.9
146	29″ -58″×5′ 0″	4	.....	.....	233	939	100	100	25	38.17	381.7	30.72	48.4	.536	7.00	34.5	.....	34.25	55.84	.....	16.78	426	.....	513	55.5	13.75	53.5	84.2	57.9	15.4	0.65	158	17.56	16.23	11.15	5.94
147	24½″-38″-64″×4′ 0″	6.82	2.4	2 836	275	1,811	160	137	25½	75⅞	607	30.6	53.3	.574	9.17	35.7	35 2	32.5	64.36	30.51	10.412	558	637	616	51.87	7.43	110	195.5	15	44	.18	34.8	432 3	16.47	12.06	9.78	4 556
148	33″-49″-77″×4′ 0″	5.79	2.344	2.46	415	2,740	160	144	26	59⅜	475	40.87	58.4	.7	8 60	32 ⅞	32.5	32.5	75	33.95	14 2	913	821	967	58	4.62	161	250	60	31	15 5	46	583 5	17 85	13.94	10.96	5.99
149	29½″-48″-78″×4′ 6″	6 99	2 647	2.047	463	2,913	160	149	27 1/16	68.35	615 15	42.7	51.9	.63	10 63	35.5	35	35.5	71.69	30 64	10.9	913	1,033	967	43.35	7	161	295	64	247.5	15 5	43.5	635 5	18 09	11	11.75	4.92
150	29½″-48″-78″×4′ 6″	6.99	2.547	2.647	463	3,202	160	157	27 1/16	71 3	641.7	34.46	54 75	.63	10.54	35.8	35.75	35⅝	78.5	34 98	9.98	1,044	1,231	926	50.5	9.57	191 9	247.5	64	247.5	15.5	43.5	635 5	20	12.08	10	5.41
151	24″ -39″-64″×3′ 6″	7.11	2.54	2.69	241	1,828	163	156.5	27	82.94	580.6	32.3	54.17	.596	10.66	28	29	17⅞	69 8	30 15	11.59	550	627	650	61.35	7	182.8	119 9	39.2	....	12.2	30	384	20 77	15.25	10	5.16
152	25½″-42″-71″×4′ 3″	7.75	2.712	2.85	352	3,002	180	174.5	25⅛	128.5	599.6	25 86	50 54	.511	11 13	17	17.4	32.2	49.22	25 26	8.99	158	208	195	59	7.25	47 5	104	58	15	0.5	....	177.5	23.64	19.36	10.8	6.32
153	25½″-42″-71″×4′ 3″	7.75	2.712	2.85	352	2,438	180	174.5	25⅝	66	561	36.22	69 53	.608	10.74	36.8	35.6	Ab't	104 6	29 4	12.4	908	692	838	57.75	11	144 5	250	188.5	55	14.65	38.6	540.8	16 87	13	9.75	4.8
154	25½″-42″-71″×4′ 3″	7.75	2.712	2.85	352	3,002	180	177.5	24½	73.5	624.75	40.05	61.85	.647	10.4	38	36	32.5	95	40 76	13.36	918	1,070	1,014	65	14.5	144 5	250	188.5	55	14.65	38.6	540.8	20.8	15.92	12	5.91
156 City of Oxford	17″ -28″-45″×2′ 9″	7.006	2.712	2.85	104	984	165	147.5	26½	105.56	686.6	30.37	.....	.572	10.16	22.75	23.5	21.5	78.9	29.1	11.37	327.1	327	330	49	6.67	43.8	95.3	58.2	12.5	0.53	.....	167.5	22.5	17	10.2	5.67
	31″ -50″-83″×5′ 0″	7.168	2 601	2.75	616	3,018	150	150	25	62.75	627.5	29.33	51 8	.566	10 75	40	40.5	Ab't	69.7	27.28	9.71	1,001	1,018	999	55	9.5	.....	.....	.....	w heels	....	.....	.....	.....	.....	.....	.....
158	22″ -42″×3′ 6″	3.644	.....	.....	87	422	110	93.5	....	45.44	318	31.65	....	....	.....	.....	.....	.....	59.64	.....	15.19	218.6	.....	205.8	.....	.....	47 4	.....	.....	0.9	0.3	.....	95.1	.....	.....	8 91	4.44
159	18″ -36″×2′ 3″	4	.....	.....	54	572	110	100 5	24¾	122.5	551	33.64	45.26	.743	7.78	18.5	....	....	48.41	.....	21.32	206.5	.....	366 3	.....	.....	46.5	22 6	.....	5.2	1 15	.....	75.4	.....	.....	12.31	7.59
160	20″ -33″-54″×3′ 6	7.29	2.722	2.677	171	1,149	160	151.6	27.7	74.94	524	31.57	.....	....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	78.4	113.8	110.4	26.8	2.35	43.4	296.1	14.65	10.4	10.1	4.53

TABLE VI. CRANK SHAFTS.

A.	B	C.	D.	E.	F.	G.	H.	K.	L.	M.	N.	O.	P.	Q.	R.	S.	T.	U.	V.	W.	No. of Bolts.	A.
10	11	19¼	2⅞	1⅝	10	18	19¼	6⅝	13⅜	13	5¼	1¼	4	7⅝	2	1½	2⅛	1¼	3⅛	2½	6	10
10¼	11¼	20⅛	3	1⅝	10¼	18⅜	19⅞	7	13⅝	13⅜	5⅜	1⅜	4⅛	7⅞	2⅛	1⅝	2⅛	1⅜	3⅛	2⅝	6	10¼
10½	11½	20⅝	3	1⅝	10½	18¾	20⅛	7⅛	13⅞	13⅝	5½	1⅜	4⅛	8	2⅛	1⅝	2⅛	1⅜	3⅛	2⅝	6	10½
10¾	11¾	21⅛	3⅛	1⅝	10¾	19	20⅜	7⅜	14⅛	13⅞	5⅝	1⅜	4⅛	8⅛	2⅛	1⅝	2⅛	1⅜	3⅛	2⅝	6	10¾
11	12	21¾	3⅛	1⅝	11	19¼	20⅝	7⅝	14⅜	14⅛	5¾	1⅜	4⅛	8⅜	2⅛	1⅝	2⅛	1⅜	3⅛	2⅝	6	11
11¼	12¼	22⅛	3⅛	1⅝	11¼	19½	21	7⅞	14⅝	14⅜	5⅞	1⅜	4⅛	8⅝	2⅛	1⅝	2⅛	1⅜	3⅛	2⅝	6	11¼
11½	12½	22⅝	3⅛	1⅝	11½	19¾	21⅜	8	14⅞	14⅝	6	1⅜	4⅛	8⅞	2⅛	1⅝	2⅛	1⅜	3⅛	2⅝	6	11½
11¾	12¾	23⅛	3⅛	1⅝	11¾	20	21¾	8⅛	15⅛	14⅞	6⅛	1⅜	4⅛	9	2⅛	1⅝	2⅛	1⅜	3⅛	2⅝	6	11¾
12	13	23⅝	3⅛	1⅝	12	20¼	22	8⅜	15⅜	15⅛	6⅜	1⅜	4⅛	9⅛	2⅛	1⅝	2⅛	1⅜	3⅛	2⅝	6	12
12¼	13¼	24⅛	3⅛	1⅝	12¼	20½	22⅜	8⅝	15⅝	15⅜	6½	1⅜	4⅛	9⅜	2⅛	1⅝	2⅛	1⅜	3⅛	2⅝	6	12¼
12½	13½	24⅝	3⅛	1⅝	12½	20¾	22⅞	8⅞	15⅞	15⅝	6⅝	1⅜	4⅛	9⅝	2⅛	1⅝	2⅛	1⅜	3⅛	2⅝	6	12½
13	14	25⅛	3⅛	1⅝	13	21	23⅜	9⅛	16⅜	16⅛	6⅞	1⅜	4⅛	9⅞	2⅛	1⅝	2⅛	1⅜	3⅛	2⅝	6	13
13¼	14¼	25⅝	3⅛	1⅝	13¼	21½	23⅞	9⅜	16⅝	16⅜	7	1⅜	4⅛	10⅛	2⅛	1⅝	2⅛	1⅜	3⅛	2⅝	6	13¼
13½	14½	26⅛	3⅛	1⅝	13½	21¾	24⅜	9⅝	16⅞	16⅝	7⅛	1⅜	4⅛	10⅜	2⅛	1⅝	2⅛	1⅜	3⅛	2⅝	6	13½
13¾	14¾	26⅝	3⅛	1⅝	13¾	22	24⅝	9⅞	17⅛	16⅞	7⅜	1⅜	4⅛	10⅝	2⅛	1⅝	2⅛	1⅜	3⅛	2⅝	6	13¾
14	15	27	4	2	14	22¼	25	10	17⅜	17	7⅜	1⅜	4⅛	10⅞	2⅛	1⅝	2⅛	1⅜	3⅛	2⅝	6	14
14¼	15¼	27⅜	4	2	14¼	22½	25⅜	10⅛	17⅝	17⅜	7½	1⅜	4⅛	11⅛	2⅛	1⅝	2⅛	1⅜	3⅛	2⅝	6	14¼
14½	15½	27⅞	4⅛	2	14½	22¾	25⅞	10⅜	17⅞	17⅝	7⅝	1⅜	4⅛	11⅜	2⅛	1⅝	2⅛	1⅜	3⅛	2⅝	6	14½
14¾	15¾	28⅜	4⅛	2	14¾	23	26⅛	10⅝	18⅛	17⅞	7¾	1⅜	4⅛	11⅝	2⅛	1⅝	2⅛	1⅜	3⅛	2⅝	6	14¾
15	16	28⅞	4⅛	2	15	23¼	26⅜	10⅞	18⅜	18⅛	7⅞	1⅜	4⅛	11⅞	2⅛	1⅝	2⅛	1⅜	3⅛	2⅝	6	15
15¼	16¼	29⅜	4⅛	2	15¼	23½	26¾	11⅛	18⅝	18⅜	8	1⅜	4⅛	12⅛	2⅛	1⅝	2⅛	1⅜	3⅛	2⅝	6	15¼
15½	16½	29⅞	4⅛	2	15½	23¾	27⅛	11⅜	18⅞	18⅝	8⅛	1⅜	4⅛	12⅜	2⅛	1⅝	2⅛	1⅜	3⅛	2⅝	6	15½
15¾	16¾	30⅜	4⅛	2	15¾	24	27½	11⅝	19⅛	18⅞	8¼	1⅜	4⅛	12⅝	2⅛	1⅝	2⅛	1⅜	3⅛	2⅝	6	15¾
16	17	30⅞	4⅛	2	16	24¼	27⅞	11⅞	19⅜	19⅛	8⅜	1⅜	4⅛	12⅞	2⅛	1⅝	2⅛	1⅜	3⅛	2⅝	6	16
16¼	17¼	31⅜	4⅛	2	16¼	24½	28⅛	12⅛	19⅝	19⅜	8½	1⅜	4⅛	13⅛	2⅛	1⅝	2⅛	1⅜	3⅛	2⅝	6	16¼
16½	17½	31⅞	4⅛	2	16½	24¾	28⅜	12⅜	19⅞	19⅝	8⅝	1⅜	4⅛	13⅜	2⅛	1⅝	2⅛	1⅜	3⅛	2⅝	6	16½
16¾	17¾	32⅜	4⅛	2	16¾	25	28¾	12⅝	20⅛	19⅞	8¾	1⅜	4⅛	13⅝	2⅛	1⅝	2⅛	1⅜	3⅛	2⅝	6	16¾
17	18	32⅞	4⅛	2	17	25¼	29⅛	12⅞	20⅜	20⅛	8⅞	1⅜	4⅛	13⅞	2⅛	1⅝	2⅛	1⅜	3⅛	2⅝	6	17
17¼	18¼	33⅜	4⅛	2	17¼	25½	29½	13⅛	20⅝	20⅜	9	1⅜	4⅛	14⅛	2⅛	1⅝	2⅛	1⅜	3⅛	2⅝	6	17¼
17½	18½	33⅞	4⅛	2	17½	25¾	29⅞	13⅜	20⅞	20⅝	9⅛	1⅜	4⅛	14⅜	2⅛	1⅝	2⅛	1⅜	3⅛	2⅝	6	17½
17¾	18¾	34⅜	4⅛	2	17¾	26	30⅛	13⅝	21⅛	20⅞	9¼	1⅜	4⅛	14⅝	2⅛	1⅝	2⅛	1⅜	3⅛	2⅝	6	17¾
18	19	34⅞	4⅛	2	18	26¼	30⅜	13⅞	21⅜	21⅛	9⅜	1⅜	4⅛	14⅞	2⅛	1⅝	2⅛	1⅜	3⅛	2⅝	6	18



SPEED OF SHIP AS AFFECTED BY SLIP OF PROPELLER.

with capacities of Scotch marine boilers; these engines and boilers having been built by one of the oldest shipbuilding firms on the Clyde. These sizes were calculated after years of experience from actual data taken from Tables III and IV, which give ratios of engines, cylinders, steam pressure, vacuum, cut-off, weights of

TABLE V.

Number of Engine.	Cylinders.	Boiler Pressure.	Mean Pressure and Maximum Initial Pressure Cards. High.	Mean.	Low.	Initial Pressure × Cylinder Area. High.	Mean.	Low.	Boiler Pressure × H. P. Cylinder Area.	Main Bearings Diameter × L.	Crank Pin Diameter × L.	Cross Head Diameter × L.	Bearing Pressure Induced by Maximum Initial Pressure × Piston Area. Boiler Pressure × Piston Area. M. Bear.	C. Pin.	× Head.	Bolts. M. B.	C. P.	× Head.	Stress on Bolts. Maximum Initial Pressure × Piston Area. M. B.	C. P.	× Head.	Piston Rod Diameter.	Revolutions.	Piston Rod. Load per Sq. Inch.	Guide Shoes.	Guides. Load per Square Inch.
138	24″ 40″ 61″	160	91.3	28.1	9.65	59,251	49,015	32,147	72,368	13⅜″×17″	13¾″×12½″	7″ ×6″	129	344.8	705.4	4 at	2 at	4 at	2,727	2,962.5	2,727	5½	69.2	4,070	7′ 6″	52.5
	3′ 9″		131	39	11								157.5	421	861.5	3″	4″	3″	3,331	3,618.4	3,331	6¼		2,359	21″ ×17″	
	10½″ 16″ 28″		72	15.16	10.575								113	302	523	4 at	2 at	2 at	1,800	3 000	3,000	2		4,210	3′ 6″	43.6
139	1′ 9″	150	103	30	15	9,348	6,030	9,235	13 614	5½″× 7⅞″	5¾″× 5⅜″	3″ ×5″	165	440	907.6	1½″	1⅝″	1⅝″	2 618	4,363	4,363	2¼	160	2,397	14¼″ × 8½″	29.5
	24″ 38″ 58″		52.9	23.24	9.71								120	362	726	4 at	2 at	4 at	2,404	2,944	2,810	4¾		4,363	6′ 8″	
140	3′ 4″	140	90	46	15	40,707	52,168	39 630	63,330	12¼″×17¾″	12¼″×11¾″	6¼″×5¾″	145.6	440	882	3″	3¾″	3¼″	3,412	3,573	3,412	5¾	82.68	2 440	21″ ×15″	51.8
	25″ 41″ 68″		78.1	27.74	9.6								Double.	322	626	4 at	2 at	4 at	1,751	2,707	2,386	5⅜		3,644	9′ 0″	87.5
	4′ 0″		114	47	16								96	407	805.5	3½″	4¼″	3½″	2,210	3,404	3 020	7	79	2,040	24″ ×15″	49.6
141	28″ 44″ 74″	160	83	31.5	10.1	55,951	62,054	58,107	78,528	13⅜″×24″	13¾″×14″	7⅛″×6¼″	121	407	805.5	4 at	2 at	4 at	1,911	2,328	2,328	6¾		3,826	9′ 6″	
	4′ 3″		110	40	15	67,727	60,820	54,515	92,355	15″ ×17″	15″ ×17″	8½″×7⅛″	133	531	724	3½″	4⅜″	3½″	2 323	3,176	3,546	8¼	68.85	1.727	24″ ×18½″	47.8
142 144	20″ 58″	150	60.24	.....	17.58	.....	.....	.....	.....	.....	.....	.....	221	1,056	I 345	4 at	2 at	4 at	3,774	5 233	3,364	5		3.364	10′ 0″	
	5′ 0″		81		28								200.1	943	1,201	2⅛″	3″	2⅛″	3.369	4,673	Cutters.	5½	38	2,781	2 at 7″×16″	76
146	24½″ 38″ 64″	100	68.6	33	11.1	53.500	51,978	73,978	66,050	11″ × 5″	7″ ×10″	5″ ×5½″	140	337	651	4 at	2 at	4 at	2 518	2 739	2,578	5⅛	78	4,570	8′ 0″	54.5
	4′ 0″		97	45	17								193.3	464.7	898	3″	4″	3″	3 472	3,771	3 472	6¼		2,460	21″ ×17″	
147	32″ 49″ 77″	150	77.04	35.825	14.175	45,726	51.030	54,689	75.424	13″ ×15″	13¼″×12½″	7″ ×6″	140	441	802	4 at	2 at	4 at	2.890	3 532	3,374	6¾		4 210	9′ 0″	
	4′ 0″		105	50	22								196	554	1,009	3½″	4¾″	3½″	3,630	4 436	4 238	8⅛	60	2. 268	24″ ×18½″	62.4
148	29½″ 48″ 78″	160	80	35.7	10.065	69,706	90.480	59,286	108,344	15⅛″×14½″	15⅛″×14¼″	8½″×7⅛″	208	406	709	4″	4¼″	4 at	2,262	3,944	2,986	6¼		4 238	9′ 0″	
	4′ 6″		102	50	14.5								253	507	857.5	4 at	2 at	4 at	2,733.6	4,770	3,601	7⅛	72.58	2,475	27½″×18″	57
150	24″ 39″ 64″	160	68.4	32.08	12.76	43.420	59,730	59,514	73.741	12½″×13″	12½″×10½″	6¼″×5¾″	187	455	833	4 at	2 at	4 at	2,750	3.370	3,218	5	84	4,877	7′ 0″	75.6
	3′ 6″		96	50	18.5								232	562	1,027	3″	3¼″	3″	3,395	4,161	3 973	6½		2 222	21″ ×12″	
151	15″ 24″ 39″	163	56.74	28.24	9.58	15,903	22,620	19,113	28.272	7¾″× 8½″	7¾″× 7⅛″	3⅝″×7″	172	383	861	4 at	2 at	2 at	2.450	3.770	3,770	3	130	5 206	5′ 0″	52.5
	2′ 4″		90	50	16								214.5	479	1 077	2″	2¼″	2¼″	3,060	4,712	4.712	3¼		2,506	14¾″× 7½″	

different parts on shipboard; and figures on indicated horsepower, grate surface, heating surface, ratio of grate surface to heating surface, steam pressure on trial trips, and total weight of boiler with or without water for corresponding boilers for the engines of Table III.

In Table V are tabulated the cylinder dimensions, boiler pressure, M.E.P., cylinder area, speed, etc., of eleven different marine engines, together with sizes of bolts and guide shoes used on same.

Table VI gives sizes of parts for crank shafts. This will be found very useful for reference in designing the details of cranks, pins, etc., for these parts have stood the test of actual mercantile marine and British Government service, being of ample proportions to carry their respective stresses, and presenting adequate bearing surface.

The chart deals with speed of ship in knots per hour. To follow this table you get slip percent; follow the line down until it cuts speed of propeller in feet per minute; then carry the line to the right; this gives the knots per hour; this table is useful on trial trips.

MOTOR BOATS, V.

BY DR. WILLIAM F. DURAND.

THE MOTOR-BOAT ENGINE.—(*Continued.*)

Carbureter.—The carbureter occupies toward the gasoline engine a relation entirely different from anything found in the steam engine or its operation. The fuel comes to the engine in the form of a liquid. Before it can be burned it must be brought to the condition of vapor mixed with a certain amount of air. It is the function of the carbureter, or vapor generator, as it is sometimes termed, to thus prepare the liquid fuel for combustion as a vapor in the engine. The importance of the carbureter and of its operation cannot be overestimated, and it is not too much to say that of the various troubles with the gasoline engine, by far the largest part are caused directly or indirectly by imperfect carburetion. The fundamental requirements for a carbureter are as follows:

(1) To produce a mixture of vapor and air within narrowly varying proportions of each.

(2) To produce such mixture independent of the speed of the engine or the temperature of the atmosphere.

(3) To use up completely the gasoline fuel, and not merely the more volatile portions, as in certain early forms.

The fundamental principle on which all carbureters operate involves the intimate mingling of gasoline and air under conditions suitable for vaporization. Vaporization is always a surface phenomenon; that is, a liquid can evaporate only at a surface which is in contact with air. The real problem consists, therefore, in bringing large surfaces of gasoline and air into contact, and under a temperature suitable for the evaporation of the former. This has been brought about in various ways. Early forms have consisted essentially of means for spreading out the gasoline in a thin layer or film and passing the air over it on its way to the engine cylinder. A further extension of this idea includes a series of wicks or layers of fibrous material in which the gasoline rises by capillary attraction and thus becomes exposed in large surfaces to the entering current of air. A variety of arrangements in detail are met with but in all cases the same underlying principle is found—the spreading out of the gasoline into a thin film exposed to the stream of inflowing air.

In a different and later type of carbureter air is allowed to bubble through the gasoline, absorbing vapor on its way and thus accomplishing the same general purpose. This constitutes in effect a fine subdivision of the air with correspondingly large surface in contact with the body of gasoline through which it is passing on its way to the engine. Many forms in detail have embodied this principle, later developments including a float

arrangement for insuring a constant level and a uniform depth of gasoline through which the air passes.

The fundamental objection to carbureters of these two forms lies in the fact that the vaporization is selective. It is readily seen that under the conditions described the more volatile portions of the gasoline will be first vaporized, leaving the heavier portions behind and causing a continuously increasing density in the residual liquid. This will tend to clog the wicks in forms using such appliances, and in all cases will gradually interfere with the operation of the apparatus as intended.

In order to obviate this fundamental objection, later forms of carbureter operate by means of a jet of the liquid fuel spurted into the stream of inflowing air. This operation gives first a mechanical spray directed into the stream of air, and this flashes quickly into vapor, thus achieving the purpose in view. By this method the fuel is vaporized completely and not selectively, and thus the body of gasoline remains of constant quality. The jet of liquid is produced by the suction of the piston on the indrawing stroke. This forms a partial vacuum in the cylinder and connecting passages, and in answer to this difference of pressure air rushes in through the air inlet, and a jet of liquid fuel likewise enters through the gasoline nozzle. Such carbureters fall into

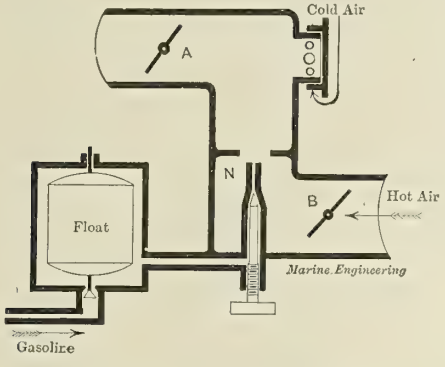


FIG. 31.—FLOAT-FEED CARBURETER.

two classes, according to whether or not a constant level of gasoline is maintained at the nozzle. These general principles are illustrated in Figures 31 and 32. In Fig. 31 is shown in schematic form a typical arrangement of float-feed carbureter. The weight of the float is so adjusted to the density of the gasoline that with the liquid in the float chamber at the level of the jet nozzle *N*, the valve at the bottom of the float will be just closed. If the level of the liquid drops, the float will drop likewise, the valve is more widely opened, and the gasoline enters at an increased rate. If, on the other hand, the level should tend to rise above the level of the nozzle, thus producing a waste at the nozzle, the float rises and closes the bottom valve tightly, thus shutting off the supply. In this manner the liquid is maintained always just at the mouth of the nozzle *N*, and ready to enter as a jet the instant the pressure is reduced by the instroke of the piston. The throttle *B* is provided to control the inflow of the air relative to the gasoline, and thus the richness of the mixture. The throttle *A* is provided to control the inflow of the mixture as a whole, and thus the power developed per stroke.

In Fig. 32 is shown a simplified form in which no attempt is made to maintain a constant level of gasoline. The arrangement consists essentially of an angle-check valve. The opening *A* connects with the cylinder and the valve is kept seated by a light spring as shown. On the instroke the valve rises under the influence of the pressure resulting from the partial vacuum on the upper side, and air enters from *B*. The gasoline enters through an opening controlled by a needle valve, and fills a channel *C*, extending around the valve casing. From this passage several small openings connect with the seat of the valve, so that the opening of the valve results as well in the uncovering of these apertures, from which the gasoline enters and is caught by the stream of inflowing air as in other forms.

In certain other patterns of carbureter a constant level is maintained by pumping an excess of gasoline into a chamber, out of which it flows through the open mouth of an overflow pipe. This maintains a constant level even with the mouth of the overflow, and then combined with this may be fitted various arrangements of air inflow and gasoline-jet passage.

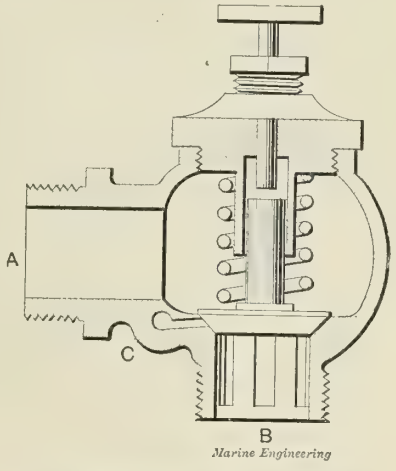


FIG. 32.—ANOTHER FORM OF CARBURETER.

On the operation of the modern typical form of carbureter increase in revolutions per minute is accompanied by a decrease in the amount of air entering per stroke, with an increase in the suction head on the gasoline, combined with a decreased time during which such head can act. Without other adjustment, however, the proportion of air will become too small with extreme speeds of rotation, and the mixture will thus become too rich for the best results. To guard against this condition an auxiliary air inlet is often provided, which is opened automatically at high speeds. This is intended to maintain the proper proportion between air and gasoline nearly constant at all speeds of rotation.

(*To be continued.*)

Dock Trials of the United States Battleship Connecticut.

The main engines of the United States battleship *Connecticut*, which is building at the navy yard, New York, were recently given a dock trial. The engines were run separately on alternate days, three days being devoted to the trial of each engine. The actual running time for each engine was about twenty hours. During the first day's trial of each engine the revolutions averaged from 35 to 40, only two boilers being used. On the second day's trial the revolutions were increased to an average of about 60, four boilers being used. On the third and last day's run eight boilers were used, the revolutions averaging between 75 and 80, the maximum being, when the engines did not race, 86 for the port engine and 84 for the starboard one.

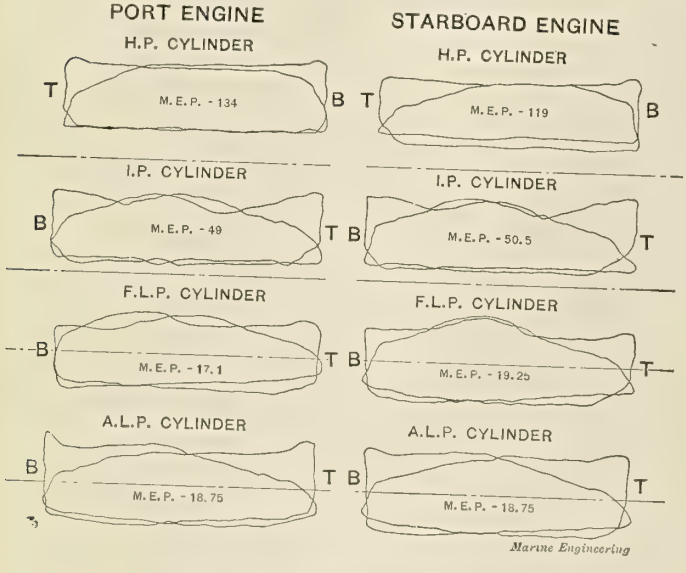
Indicator cards were taken at various speeds from each engine, the results plotted on cross-section paper, and the revolution-power curve constructed as shown. It will be noticed that the starboard engine required more horsepower for the same number of revolutions than the port one. This was due to the starboard side of the ship being next to the dock. The port engine showed a tendency to race, and at one time the revolutions reached 104 per minute without any increase in the steam pressure. It will be interesting to compare this curve with a similar one in free route, which will be drawn when the screws are standardized for the preliminary contract trial. With the same mean pressure upon the pistons as the cards show for the higher revolutions at the dock, the revolutions should be, in free route, a little over 120 per minute.

Although this was the first time the engines had ever been turned under steam they ran easily and smoothly, apparently being in perfect adjustment. No water was used on any of the bearings, nor allowed to circulate through any of the hollow brasses or guides, with the exception of the thrust bearings, when, owing to the increased thrust due to the ship being fast to the dock, water was allowed to circulate through the cooling coil and to a limited extent through the hollow horseshoes. The results of this trial show the excellent character of the work done by the employees at the New York navy yard.

The principal dimensions of the *Connecticut* are as follows:

Length	450 ft. 0	ins.
Beam	76 ft. 10	ins.
Draft, normal	24 ft. 6	ins.
Draft, full load	26 ft. 9¼	ins.
Displacement, normal	16,000	tons
Displacement, full load	17,666	tons
Speed at normal displacement	18	knots

The engines are designed for a total of 16,500 horsepower at 120 revolutions, with 265 pounds steam pressure at the boilers. They are of the usual vertical, four-cylinder, triple-expansion type, the high- and intermediate-pressure cylinders being in the center, and one low-pressure cylinder at each end. The cranks for the forward pair of cylinders and also for the after pair are opposite to each other, while the two pairs are set at right angles. The framing is all of forged steel, consisting of vertical columns well trussed by suitable stays. Piston valves are used on all the



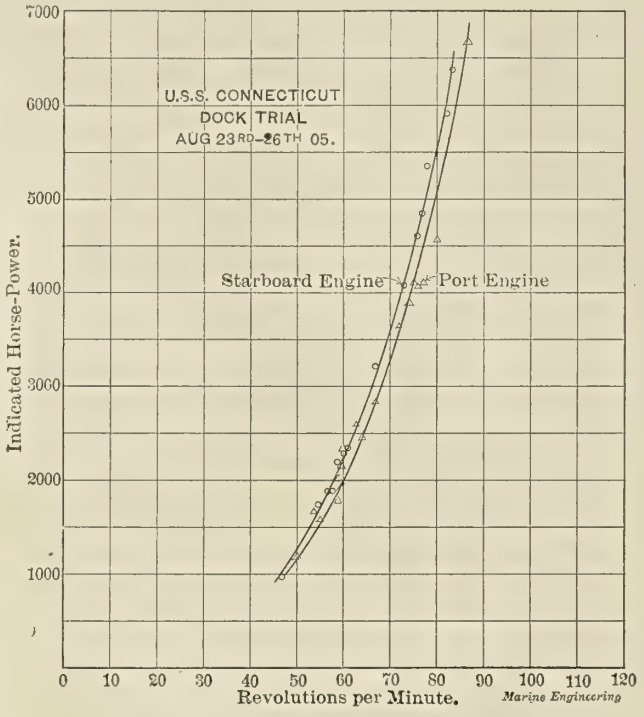
SAMPLE INDICATOR CARDS FROM THE CONNECTICUT.

cylinders and are worked by the usual double-bar Stephenson link motion. The crank shafts are hollow, forged in two sections, each section having two cranks opposite to each other. This is done to keep the cylinders as close to each other as possible, and thus reduce the vibration.

The principal dimensions of the engines are as follows:

Diameters of the cylinders	32½, 53, and two of 61	ins.
Stroke	48	ins.
Diameter of piston rods	7¼	ins.
Length of connecting rods between centers	96	ins.
Diameter at neck	6⅞	ins.
Diameter at crank end	8	ins.
Diameter of crank pins	17½	ins.
Length of crank pins	19	ins.
Diameter of crank-shaft bearings	16½	ins.
Length of crank-shaft bearings	19½	ins.
Cooling surface of each condenser	10,375	sq. ft.

The boilers are of the Babcock and Wilcox type, having 52,752 square feet of heating surface and 1,097 square feet of grate surface, a ratio of 48.1 to 1.



POWER-REVOLUTION CURVES FROM DOCK TRIAL.

A sample set of cards from each engine is shown.

RESULTS OF TRIAL.

	PORT ENGINE.	STARBOARD ENGINE.
Revolutions per minute	86.	83.
I. H. P., high-pressure cylinder	2,260.78	1,942.35
I. H. P., intermediate cylinder	2,232.11	2,221.42
I. H. P., forward low-pressure	1,035.01	1,124.09
I. H. P., after low-pressure	1,134.49	1,094.89
I. H. P., collective	6,662.39	6,382.75
Steam pressure, per gauge	265.	255.
First receiver pressure, absolute	98.	98.
Second receiver pressure, absolute	35.	32.
Vacuum, in inches	25.5	25.5
Total indicated horsepower	13,045.14	

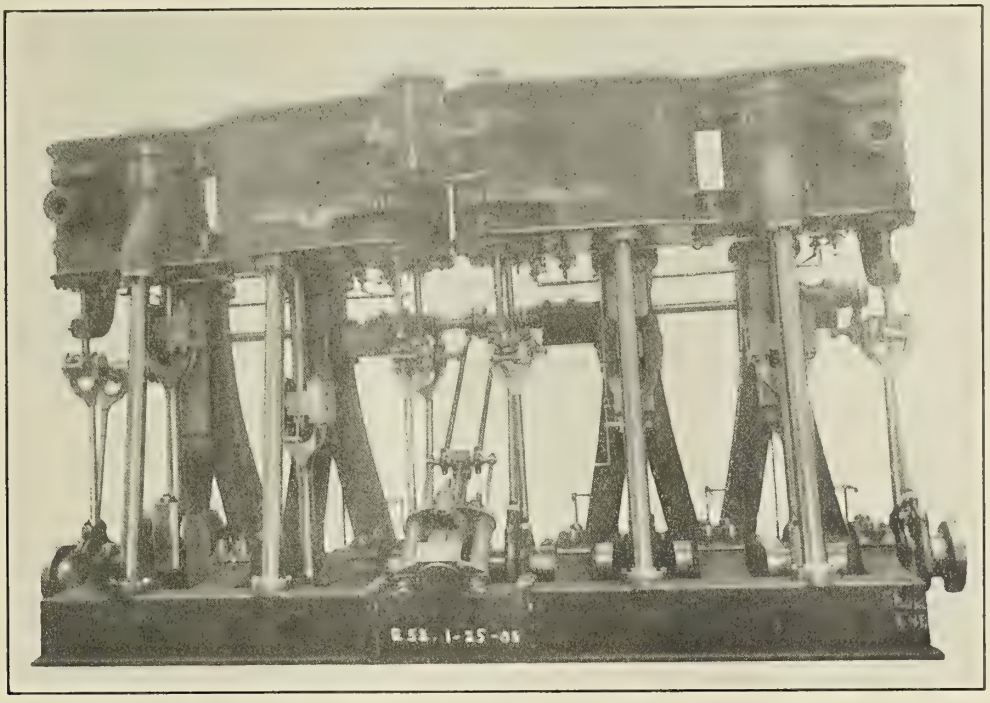
H. P. Norton.

Trial Trip of Ferryboat Manhattan.

On June 22 the Maryland Steel Company sent down the Patapsco River and Chesapeake Bay for an official trial trip the new ferryboat *Manhattan*, which they have built for the city of New York service between the Battery and Staten Island, and which has been described at considerable length in our columns in three or four numbers during the past year or more.

These boats have a length over all of 250 feet; length between perpendiculars, 246 feet; a molded beam of 46 feet; an extreme beam over the guards of 66 feet, and a depth of 19 feet 6 inches. At the time of the trial trip the draft at what has been called the "shore" end was 11 feet 10 inches, while that at the "water" end was 11 feet 8 inches, giving a mean draft of 11 feet 9 inches. This corresponds with a displacement of 1,376 tons, and a wetted surface of 9,480 square feet. The water tanks were full, and the coal bunkers contained 60 tons.

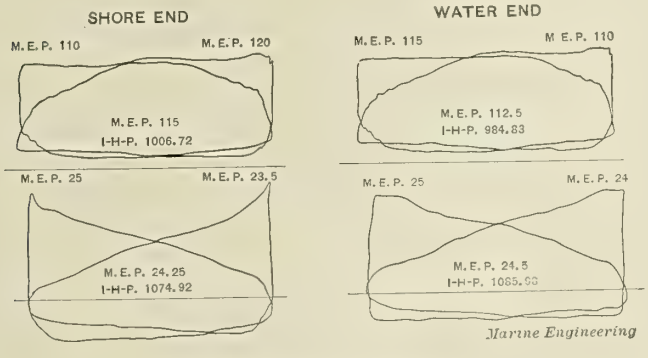
The table giving the log of the trial trip shows a mean speed on the down trip of 15.34 knots, or 17.67 miles per hour. The same figures for the up trip were 15.16 and 17.47. This makes the average speed for the trial 15.25 knots, or 17.57 miles per hour.



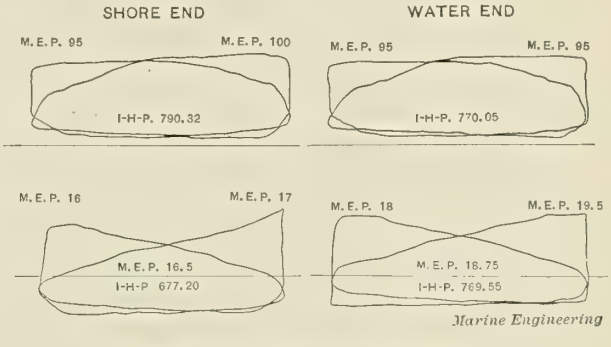
DOUBLE COMPOUND ENGINES OF FERRYBOAT MANHATTAN.

The boat is propelled by a double compound engine coupled together, with a continuous shaft carrying a propeller at each end of the boat. The cylinders measure 22½ and 50 inches in diameter, with a stroke of 30 inches. We present a photograph of this engine.

The boilers, which are of the Babcock and Wilcox marine type, are four in number, and work under a pressure of 225 pounds per square inch. The total grate surface is 340 square feet and the heating surface is 12,500 square feet, this giving a ratio between the two of 36.8 to 1. The propellers have a diameter of 11 feet, and with a pitch ratio of 1.3 the pitch works out at 14 feet 4 inches.



CARDS TAKEN AT FULL POWER.



CARDS TAKEN AT THREE-FOURTHS POWER.

Run.	Time. h. m. s.	Distance Between Points. Statute Miles.	Distance Between Points. Nautical Miles.	Speed. Statute Miles.	Speed. Knots.	Mean R. P. M.	Mean Steam Pressure.	Mean I. H. P.	Slip. %
A *.....	0 30 3	8.5	7.4	16.98	14.76	147.3	150	3,865	28.4
B *.....	1 1 22	17.5	15 2	16.78	14 58	147	147	3,832	30.6
C*	0 56 25	17.5	15.2	18.37	15.90	145.6	145	3,670	25
Total* ...	2 27 50	43.5	37.8	17.67	15.34	146.5	146.8	3 773	27.9
C †... ...	0 59 43	17.5	15.2	17 34	15.06	141	143	.....	24.4
B †.....	1 2 19	17 5	15.2	16.58	14.40	141.6	145	. ...	27.9
A †.....	0 27 33	8.5	7.4	18.54	16.10	152.8	155	... .	25.5
Total †....	2 29 35	43.5	37.8	17.47	15.16	143.6	146.2	.....	26

* Down, against wind, against tide.
† Up, against tide, with wind.
A, between Sandy Point and Thomas Point. B, Between Thomas Point and Sharp's Point. C, Between Sharp's Point and Cove Point.

The following table is of unusual interest, showing as it does how the displacement of the ancient and modern ship will add up:

Weight as a Percentage of the Total Displacement.	74-gun Ship, 1805.	Battleship, 1905.
General equipmeut.....	20 (Ex-masts.)	4
Armament.	10	19
Propelling arrangements	8.5 (Masts, sails, and rig.)	10.5
Coal.....	0	5.5
Ballast.....	6.5	0
Armor.....	0	26
Hull.....	55	35
	100	100

GOVERNMENT DREDGE FOR DELAWARE RIVER.

This dredge, the sixth of similar type built by the Maryland Steel Company for the Engineers' Department of the United States Army, is the largest and finest of the lot. Designs of hull, machinery, pumping engines, and pumps were furnished by Capt. E. O. Patterson of the Engineers' Department, who is superintending the construction, under orders of Major J. C. Sanford.

The operation of the dredge is similar to that described in our issue of July, 1904, for the New York harbor dredges.

HULL.

General dimensions are as follows:

Length, between perpendiculars	300 ft. 0 ins.
Length, over all	315 ft. 0 ins.
Beam, molded	52 ft. 0 ins.
Depth, molded	22 ft. 6 ins.

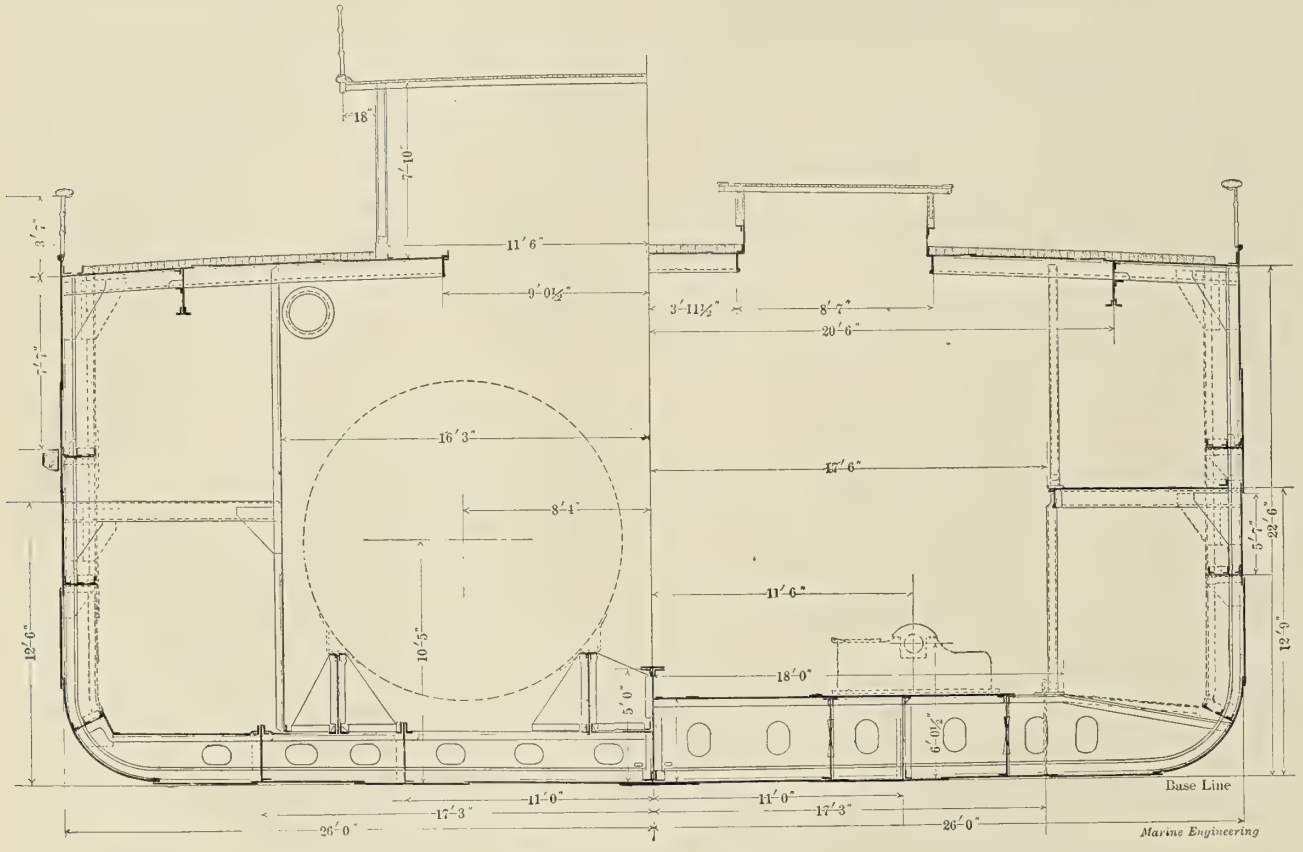
The hull is of mild steel throughout. The lower part of stem is cast steel and the upper part of rolled bar. The stern post is cast steel. The rudder is of single-plate type with forged stock and arms keyed. The extension stock is forged steel, bolted and keyed to palm on head of rudder stock. The frames are bulb angles, 7 inches by 3½ inches by 23 pounds, spaced 24 inches centers except at gates, where they are spaced 30 inches and 18 inches to accommodate same. At ends the frames are reduced to 21 pounds. Floors are 44 inches deep in way of bins and under engines, and 27 inches deep forward and aft of these spaces and under boilers. Under the engines the floors are plated on top, forming a feed-water tank. The reverse bars are fitted on top of floors only, extending from bilge to bilge continuous through center keelson. The center keelson is 60 inches by 25 pounds continuous, connected to flat-plate keel by double angles 6 inches by 4 inches by 20 pounds. Continuous angles of same size are fitted on top of floor stringers, which are 20 inches by 26 pounds to 20 pounds. At top of center keelson are double 6 inches by 4 inches by 20 pounds continuous angles with rider plate 12½ inches by ⅝ inch. There are two intercostals on each side, 25 pounds, flanged to shell and extending above floors, connected to double 6 inches by 4 inches by 20 pounds keelson angles. The bilge stringer consists of a 25-pound plate scored over frames with intercostal angle to shell. At the inside line of frames and inside line of plate are single continuous angles 4 inches by 4 inches by 12 pounds. One side stringer is fitted, consisting of an 18 inches by 25 pound plate with intercostal angle to shell and single angles at line of frame and inside line of plate.

The main-deck beams are bulb angles, 10 inches by 38 pounds, fitted on every frame. Tower-deck beams are bulb angles, 10 inches by 32 pounds, fitted on every frame forward and aft of bins. In wake of bins a built-up beam consisting of a 21 inches by 17½ pounds plate and double angles 3½ inches by 3½ inches by 8½ pounds is fitted to every frame except opposite center of gate openings, where a 10 inches by 32 pounds bulb angle is fitted continuously from side to side of ship to take gate-rod guides. The main deck is completely plated with wooden deck laid and calked. The lower deck is plated forward and aft of bins.

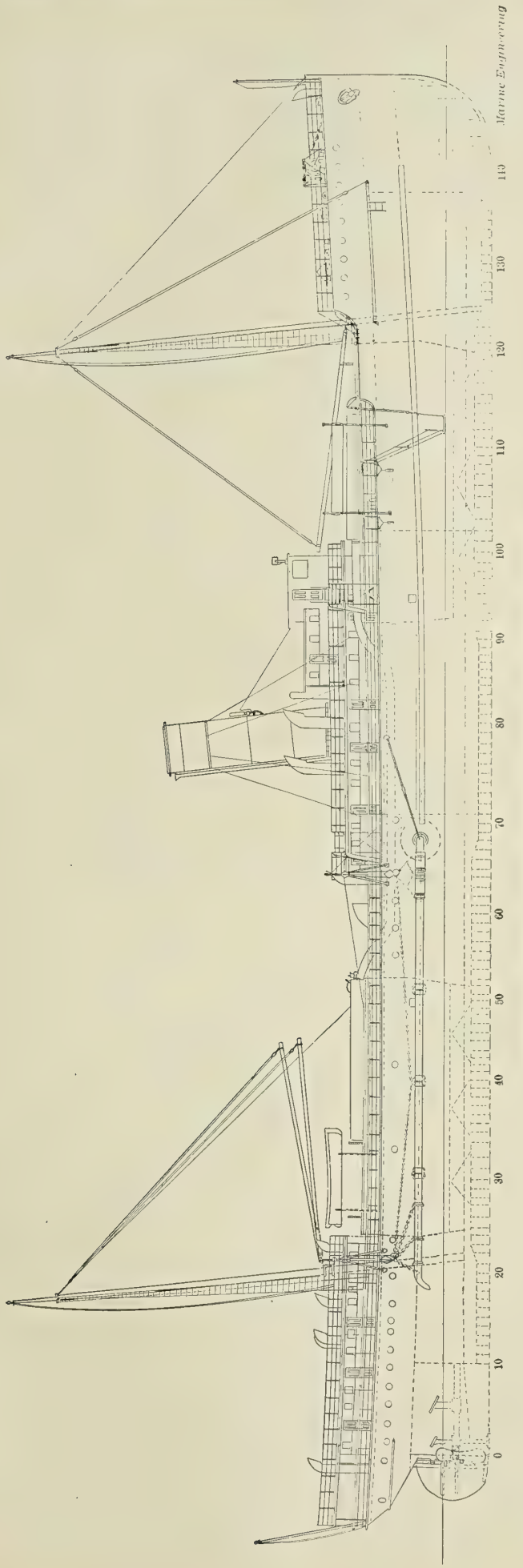
There are four watertight bulkheads: a forward collision; one abreast of forward bin; one between engines and boilers; and a stern-tube bulkhead. The coal bunkers are in the wings, extending full length of boiler space.

A forecastle deck is fitted, extending 50 feet from stem, with wood deck laid on same. Underneath are quarters for firemen and sailors, with toilets and separate galley. The windlass is on forecastle deck, with engines on same bed plate.

The sand bins are two in number, one forward and one aft of machinery space. The combined capacity is 2,200 cubic yards. The bulkheads forward and aft, and the side bulkheads, are well stiffened by bulb angles. In addition to these, large channel strong-backs are fitted to the end bulkheads, and heavy tie rods connect the forward and after strong-backs together. There are eight openings in each bin, with frames and gates of cast steel. The gates are so arranged that when open they are entirely above the lower edge of ship, which permits of dumping in shallow

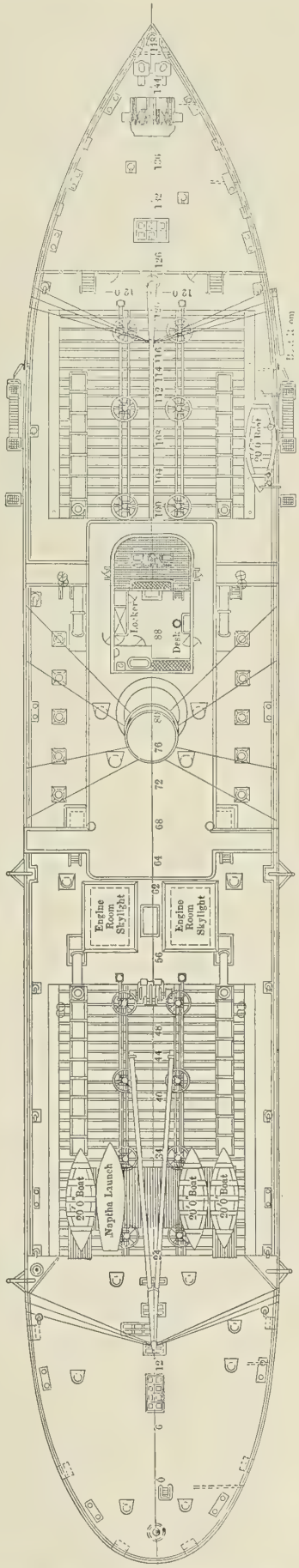


MIDSHIP SECTION OF DREDGE.



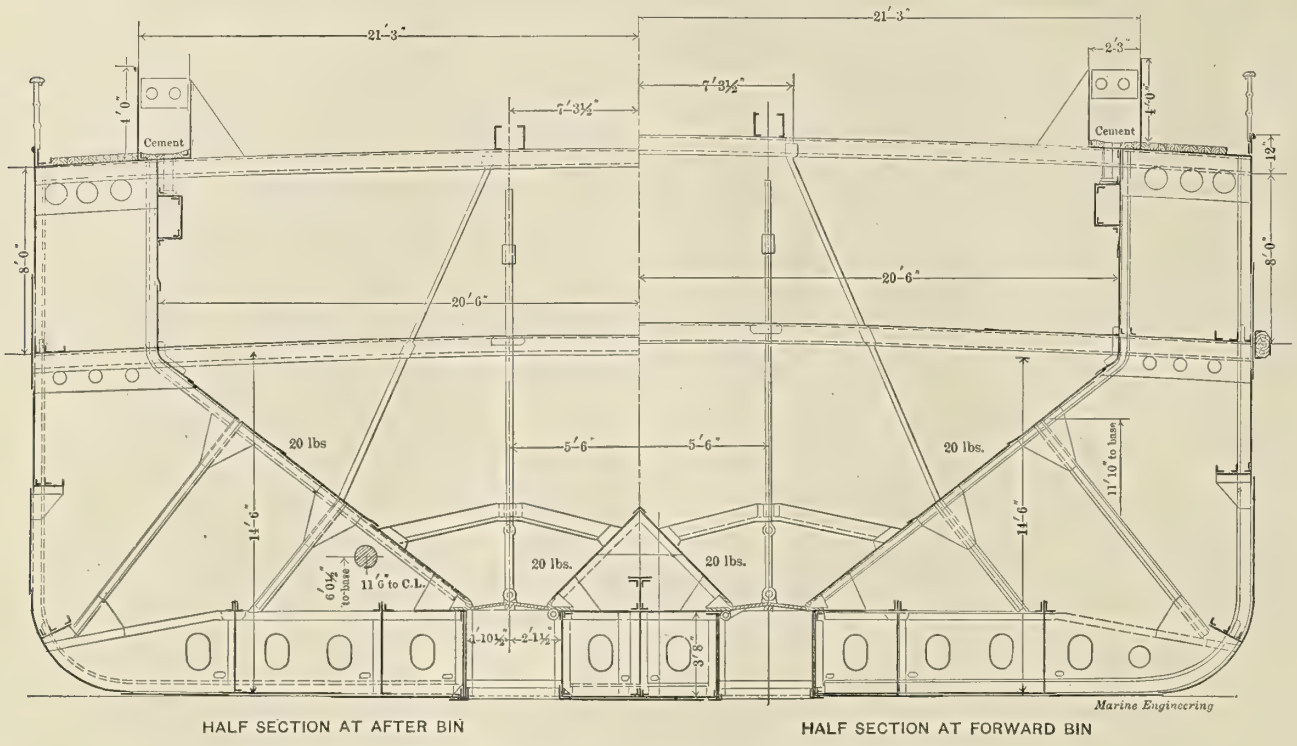
OUTBOARD AND PARTIAL INBOARD PROFILE OF SUCTION DREDGE, WITH RIGGING PLAN.

water. The bottoms of bins are fitted with hips, causing the sand to trim to openings. The gates are opened and closed by rods

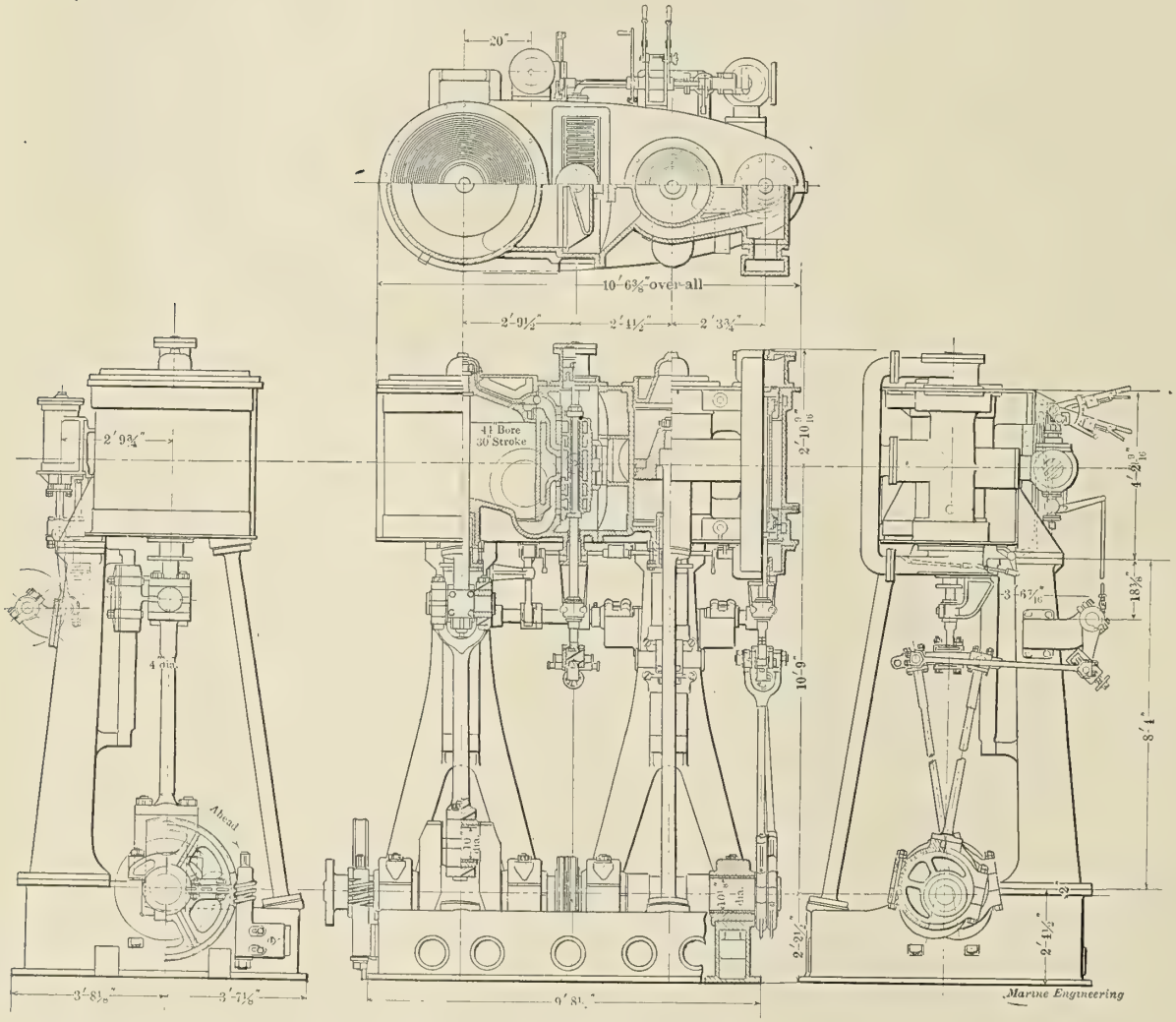


DECK PLAN OF SUCTION DREDGE FOR DELAWARE RIVER.

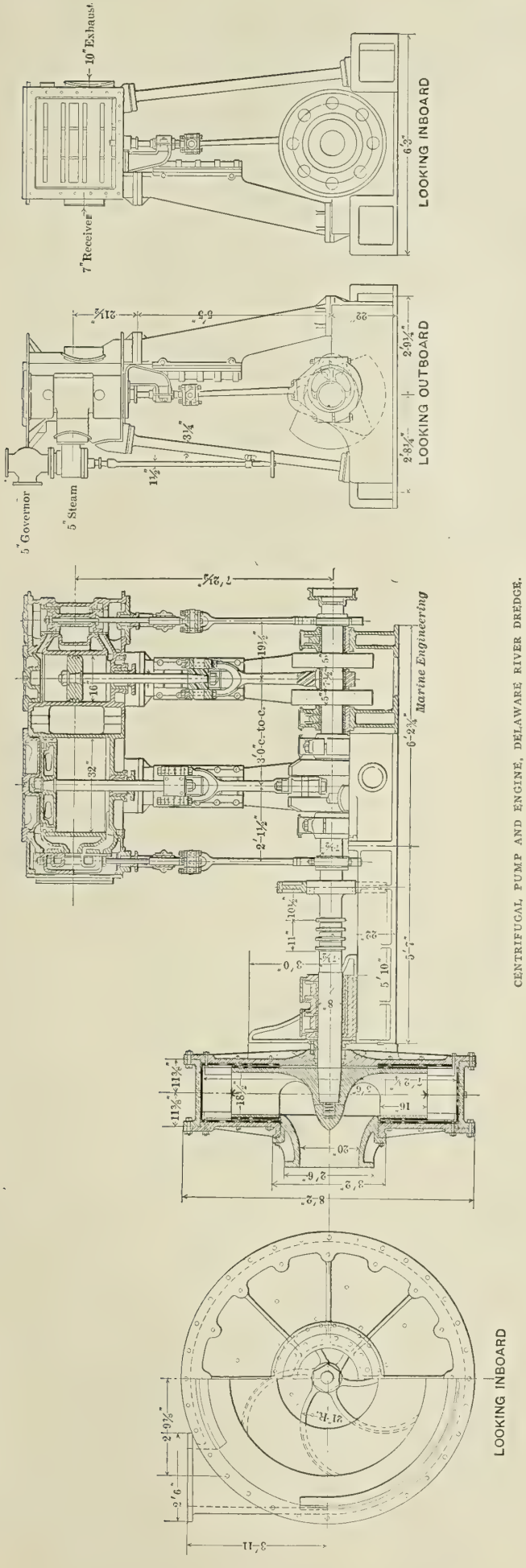
running above main deck, where they are geared to a continuous shaft, operated by a double 6- by 6-inch engine. There



SECTION OF DREDGE, SHOWING HOPPER CONSTRUCTION.



PROPELLING ENGINE OF DREDGE.



CENTRIFUGAL PUMP AND ENGINE, DELAWARE RIVER DREDGE.

are four of these engines, two for forward bin and two for after one, each one operating four gates. A friction cone with spring is fitted at each gate rod, which localizes any irregularity which may occur in the time of closing the various gates.

The officers have quarters in deck house aft, and the captain in house on top of midship house. This house also contains pilot house. The midship house covers boilers and pumping engines, and in forward end has a machine shop and the steering engine. The officers' quarters are finished in selected cherry, paneled in captain's room. All have floors of oak.

Large skylights are fitted over the propelling engines.

Bridges extend to side of ship at forward and after end of midship house, for navigating and dredging purposes, and the throttle for engines and operating gear for valve in Y-pipe is operated from top of this house. The roof of after-deck house extends to rail, forming shade deck.

There are two masts, rigged schooner fashion, with one derrick boom on forward and two on mainmast.

Two winches are fitted on lower deck aft. with davits and falls for operating suction pipes.

The windlass and hoisting engines are made by the Hyde Windlass Company, Bath, Me., and the steering engine by Williamson Brothers, Philadelphia.

The compound propelling engines are two in number. The high-pressure cylinders are 22 inches and the low-pressure cylinders 44 inches in diameter; all of 30 inches stroke. The high-pressure cylinders are fitted with piston valves, and the low with double-ported slide valves. The valve gear is of Stephenson double-bar link type. The pistons are cast steel, with cast-iron followers.

The condenser is independent, of circular shape. The cooling surface is 4,011 square feet. An auxiliary condenser is also fitted for pumping engines, with 1,501 square feet cooling surface.

The air pump is twin-cylinder, vertical-duplex, double-acting, with steam cylinder 16 inches diameter and air cylinder 30 inches diameter, 18 inches stroke. The circulating pump is 12 inches diameter with 8- by 8-inch engine. The auxiliary circulating pump is 8 inches diameter with 6- by 6-inch engine. There are three boiler and bilge pumps, vertical-duplex, brass lined, 9 inches by 6 inches by 10 inches. The sanitary pump is vertical-duplex, 7½ inches by 4½ inches by 10 inches. An air-compressor pump of vertical-simplex type, 4½ inches by 5½ inches by 4½ inches, is connected to a 500-gallon pressure tank. The feed heater is supplied by the James Reilly Repair and Supply Company, New York. The fire pump is 14 inches by 8 inches by 12 inches vertical-duplex.

The two pumping engines are compound, with high-pressure cylinders 16 inches, and low-pressure cylinders 32 inches diameter, all of 18 inches stroke. The high-pressure cylinders are fitted with piston valves, and the low-pressure cylinders with double-ported slide valves. Each engine is direct connected to a 20-inch centrifugal pump built by the Ellicott Machine Company.

There are four Scotch boilers placed two forward and two aft, with thwartship fire room between. The boilers are 14 feet in diameter by 12 feet long, built for a working pressure of 125 pounds. Each boiler has three 42-inch Morison furnaces. The total grate surface is 280 square feet, and the total heating surface is 10,680 square feet, giving a ratio of 38.14 to 1. Natural draft is used.

The two propellers are 10 feet in diameter, 11 feet 6 inches pitch, of cast steel, solid wheels. The developed area of one wheel is 48 square feet.

The electric-light plant consists of two 25-Kw. generators direct connected to 7- by 9-inch engines. There are 220 16-candle-power lamps, 3 of 50 candle-power, and one searchlight of 35 amperes capacity on top of pilot house.

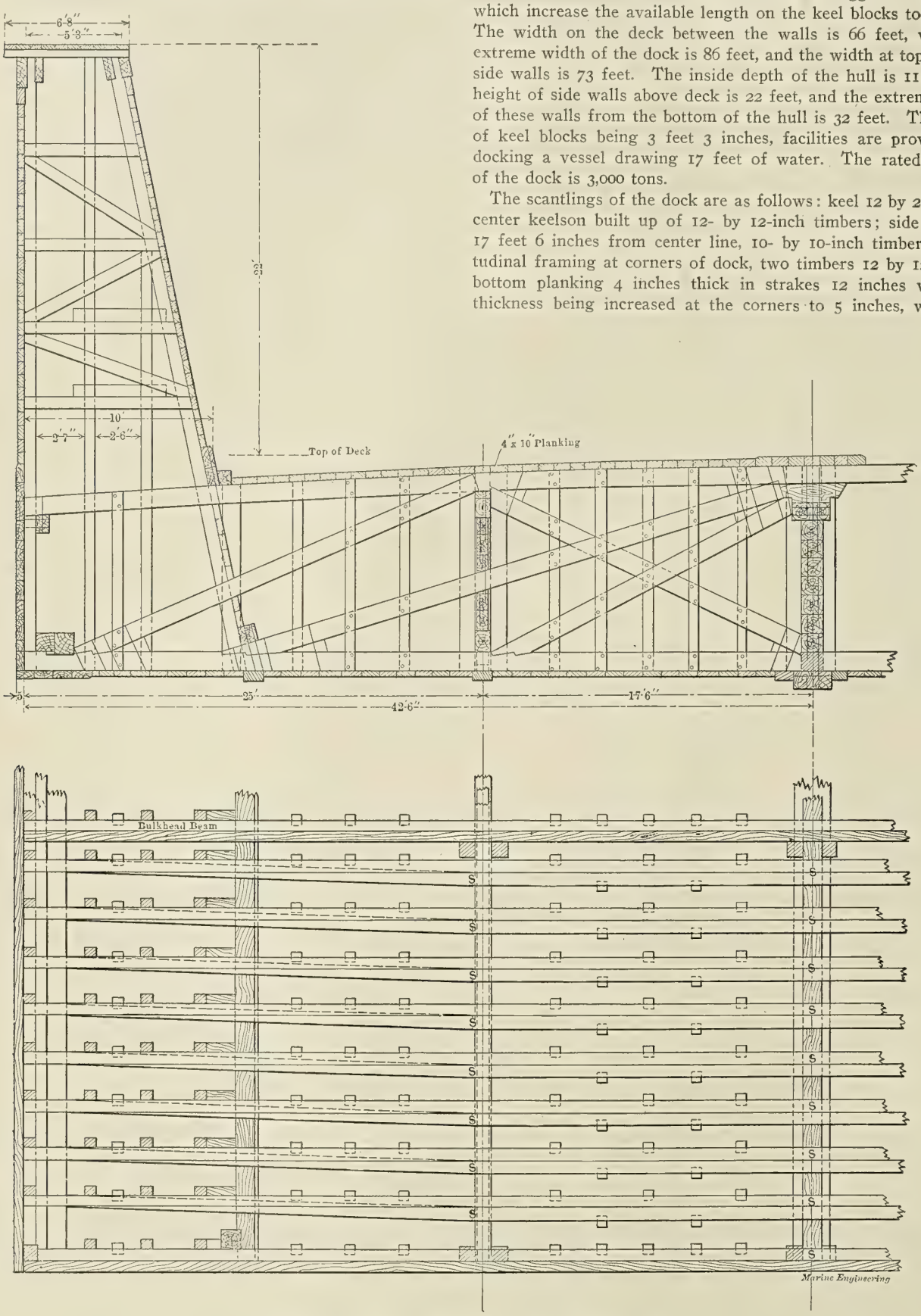
There are two 20-inch diameter suction pipes, one on each side of slip, with cast steel drags similar to that shown in our recent article on New York harbor dredges. T. M. C.

A Wooden Floating Dry Dock at Mobile.

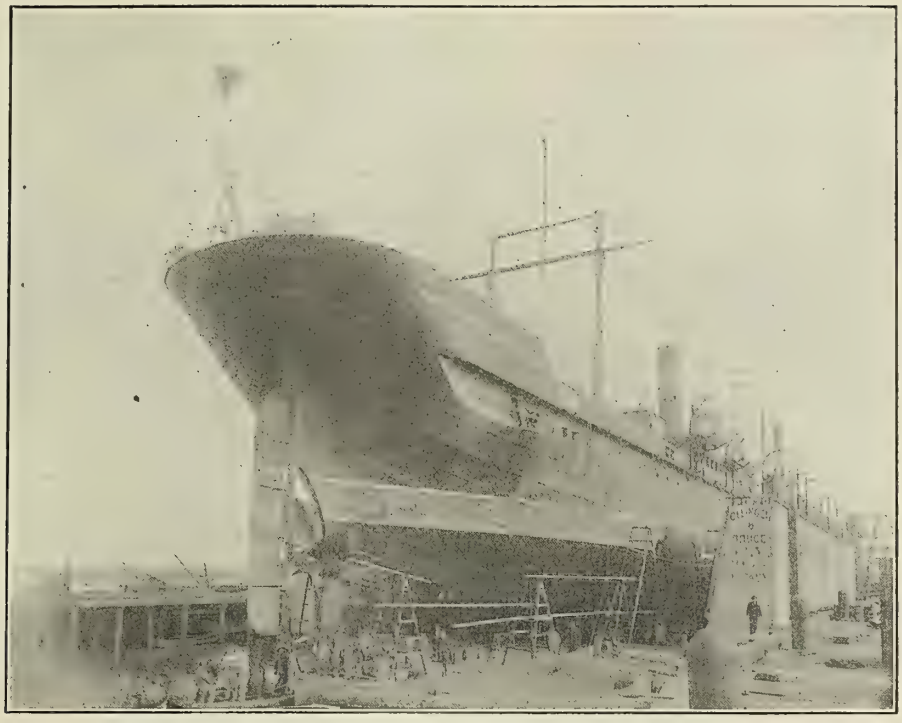
The rapidly increasing maritime importance of Mobile, with its many lines of freighters, lumber, cotton and cattle steamers, tramps and numberless schooners, has rendered it an absolute necessity to provide the port with a dry dock of sufficient capacity to take care of constantly recurring demands for general repairs. This long-felt need has now been met by the construction and putting into service of a floating dry dock built of wood by the Ollinger & Bruce Dry Dock Company, and operated by them.

The dock, of which we present a number of illustrations, has a length of hull of 232 feet, but there are outriggers at each end which increase the available length on the keel blocks to 312 feet. The width on the deck between the walls is 66 feet, while the extreme width of the dock is 86 feet, and the width at top between side walls is 73 feet. The inside depth of the hull is 11 feet, the height of side walls above deck is 22 feet, and the extreme height of these walls from the bottom of the hull is 32 feet. The height of keel blocks being 3 feet 3 inches, facilities are provided for docking a vessel drawing 17 feet of water. The rated capacity of the dock is 3,000 tons.

The scantlings of the dock are as follows: keel 12 by 24 inches; center keelson built up of 12- by 12-inch timbers; side keelsons 17 feet 6 inches from center line, 10- by 10-inch timbers; longitudinal framing at corners of dock, two timbers 12 by 12 inches; bottom planking 4 inches thick in strakes 12 inches wide, the thickness being increased at the corners to 5 inches, while one



HALF CROSS-SECTION AND PARTIAL PLAN OF MOBILE FLOATING DOCK.



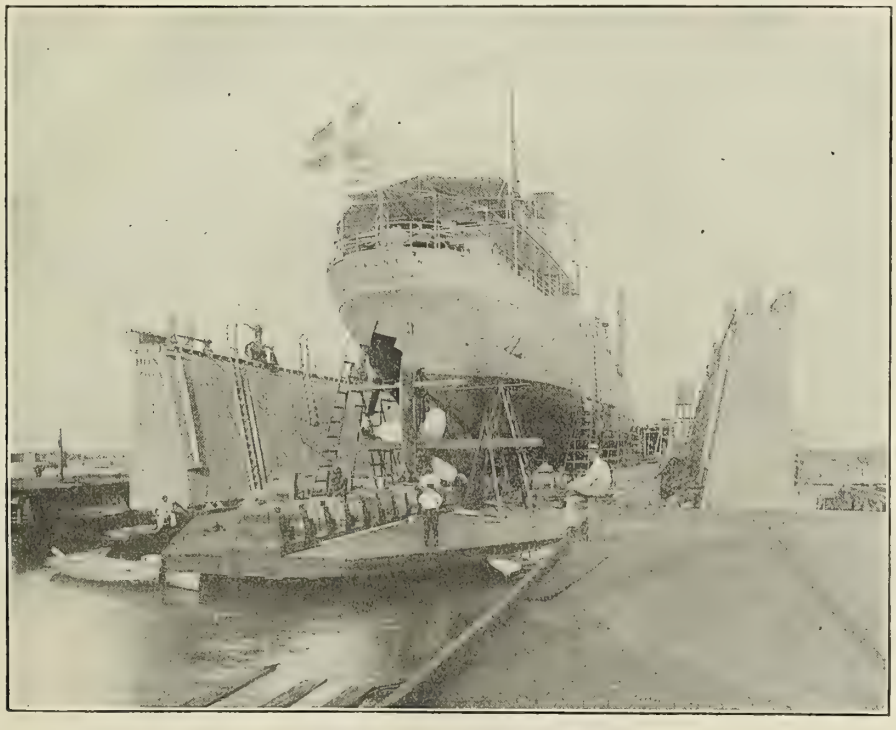
STERN OF STEAMER OVERHANGING END OF DOCK.

(Photograph, Wm. E. Wilson.)

strake under the inside edge of side walls has a thickness of 8 inches; deck planking 4 inches thick in 10-inch strakes, increased to 8 by 12 inches under the keel blocks; side planking 5 by 12 inches to the level of the deck, and 3 by 8 inches on side walls above that level and upon top of side walls. Diagonal struts, measuring 8 by 12 inches, are run from the upper part of center keelson immediately under keel blocks to the base of intermediate side keelsons, and to the foot of inside edge of side walls, in each case being mortised into the 8- by 12-inch transverse bottom frames. Diagonals of this same size are also run from the top of intermediate side keelsons to the base of center-line keelson, and also to the lower corners of the dock, being mortised as in the other case. The deck beams are also 8 by 12 inches.

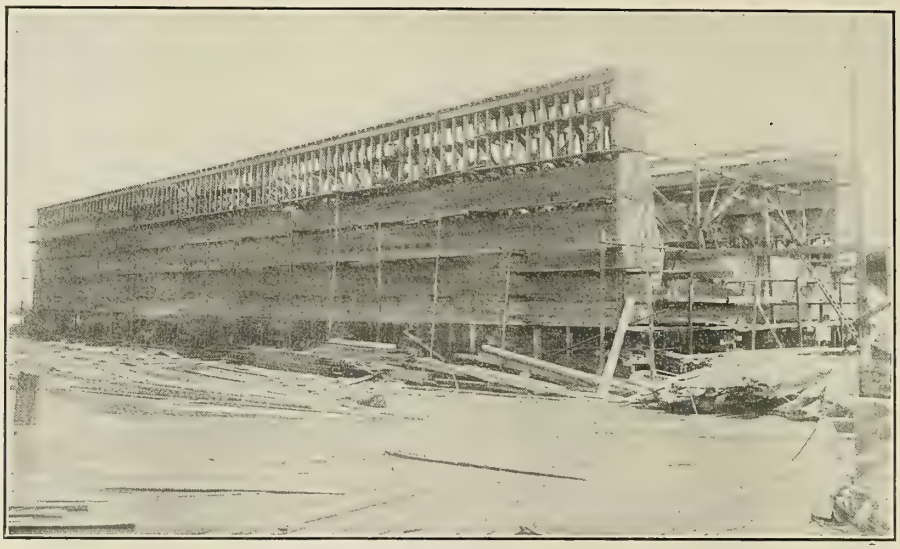
The vertical transverse and diagonal scantlings of the side walls are all 6- by 8-inch timbers.

Patent adjustable keel blocks are used throughout the dock. The fastenings are all of galvanized iron. The splendid qualities of long-leaf southern yellow pine, together with the long lengths obtainable, rendered this material an ideal one for the construction of the dock. All of the timber entering into the



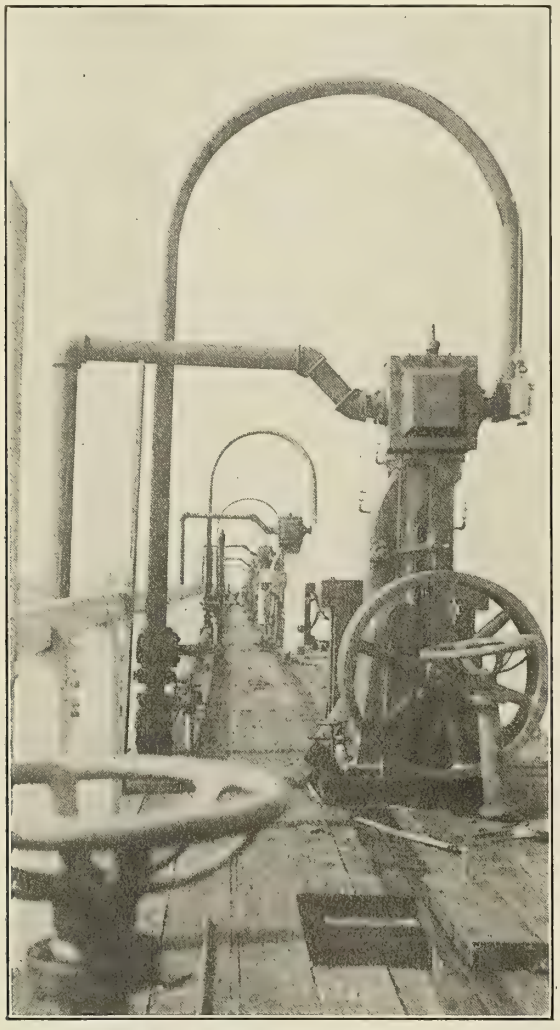
STEAMSHIP TAUNTON IN MOBILE DOCK.

(Photograph, Wm. E. Wilson.)



THE DOCK UNDER PROCESS OF CONSTRUCTION.
(Photograph, Wm. E. Wilson.)

construction was treated with timber preservatives before being used. A very complete pumping system has been installed, consisting of ten 13-inch centrifugal pumps, each operated by a separate upright engine, as shown in one of our photographs. The pumping system was installed by the Bolander & Schwind Company, of New Orleans. Two large safety water-tube boilers furnish the necessary steam for the pumps, under a maximum working pressure of 150 pounds per square inch. They were furnished by the Ivans Company, of St. Louis. Patent swivel joints are used in connection with the 8-inch steam-supply pipes.



WING WALL, SHOWING PUMPING ENGINES.

The capacity of the pumps is three million gallons per hour. The engines are situated on the top of the side walls and are geared direct to the pump shaft, while the steam for them is supplied by the boiler plant on shore at the head of the slip.

The slip in which the dock is permanently located was dug out of a solid sand bank, and in the process of preparing it it was found necessary to use large quantities of dynamite to remove the old wrecks of defunct steamboats found buried on the site. Two of our illustrations show vessels on the dock, and in one case it will be noticed that the ship overhangs the length of the dock by a considerable amount. This ship, which is the *E. O. Saltmarsh*, of London, measures 3,230 tons gross, 2,312 tons net, has a length over all of 350 feet, a beam of 50 feet, extreme depth 32 feet, and a displacement at the time of docking of 2,600 tons. This vessel was lifted out of the water until the dock had 15-inch freeboard at lowest point of deck line in thirty minutes after being located on the blocks.

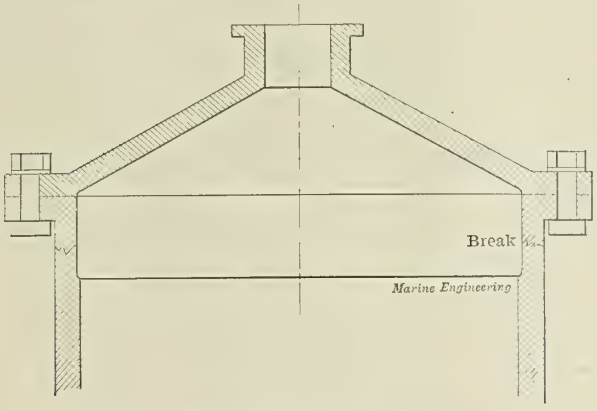
The plans of the dock were drawn by the builders from plans of a smaller dock owned by the Tietjen & Lang Dry Dock Company, Hoboken, and the dock was constructed under the general superintendence of Mr. Charles N. Crowell, of Orange, Texas.

Rapid Repair Work on the Majestic.

When the steamship *Majestic*, of the White Star Line, came limping into New York harbor early in July under her port engine, with the starboard engine room a mass of wreckage, it was thought that a very considerable time must elapse before the ship could again be put into service. The breakdown was due to the fact that the crosshead pin on the intermediate cylinder of the starboard engine had broken, allowing the connecting rod to wreck the back housing of the frame, while the piston on the next stroke jumped up through the top of the cylinder, tearing off the cylinder head by rupturing the barrel just below the upper flange, as shown in the sketch. The cylinder head bolts held tight, so that the upper flange and cylinder head were thrown off in one piece.

It was discovered upon further examination that the high-pressure and low-pressure engines had not been seriously disturbed, and under the direction of Mr. Barber, chief engineer of the *Majestic*, the wreckage was cleared away and temporary repairs made by Alexander Reid, engineer, of New York. These repairs consisted in the main in removing the steam connections between the high and intermediate cylinders, and between the intermediate- and low-pressure cylinders, and substituting a 36-inch copper pipe ⅜ inch thick, running from the exhaust

openings of the high-pressure valve chest to the steam opening of the low-pressure valve chest. This work was performed so expediciously that although the *Majestic* was two days late getting into port, on account of the delay caused by the breakdown, she sailed on time, using the port engine triple expansion and the starboard engine as a compound.



SKETCH SHOWING BREAK IN CYLINDER.

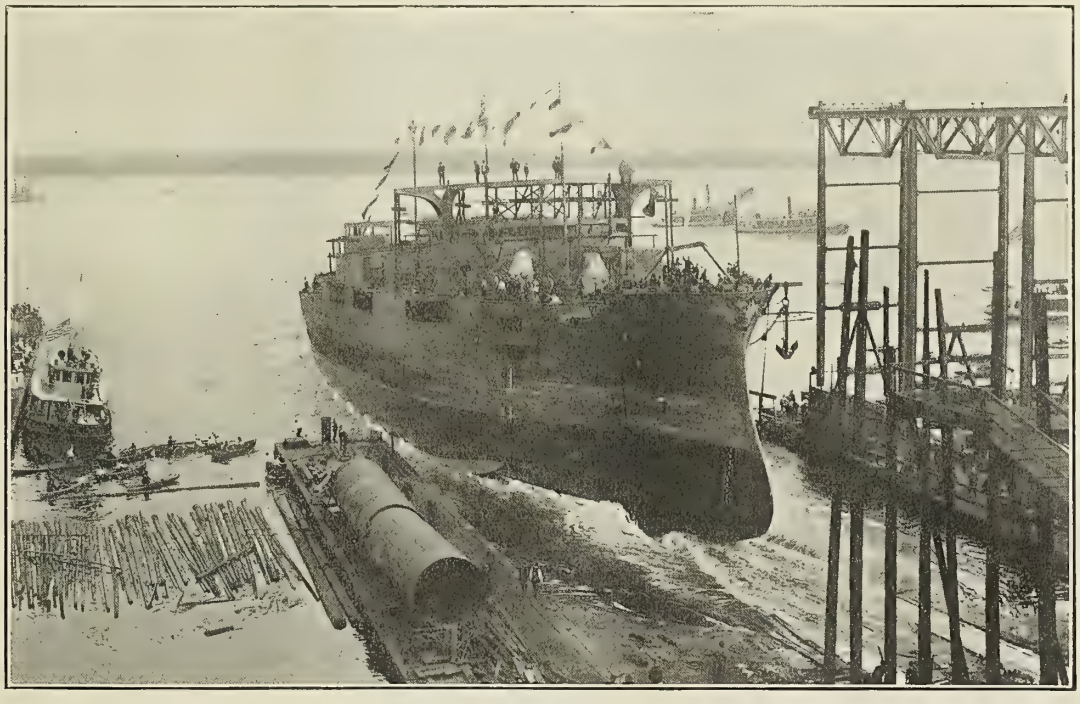
Arriving at her destination in England, the *Majestic* was placed in charge of Messrs. Rollo & Sons, of Liverpool, for permanent repairs, and although it was found necessary to practically reconstruct the intermediate-pressure engine, involving in all the casting and machining of more than forty-five tons of material, yet this contract was taken with a promise to deliver the ship for trial trip in six and a half weeks from its date. The castings were started under the supervision of Mr. Willet Bruce, superintending engineer of the line, before the arrival of the *Majestic*, from measurements taken from the engines of her sister ship *Teutonic*, and, as a result, the *Majestic* was enabled to make her next trip after having missed only one round trip between England and the United States.

This record is a splendid one for the engineers at both ends of the line, and one of which they may well be proud.

Thirteenth Annual Meeting of the Society of Naval Architects and Marine Engineers.

An unusually interesting list of papers is promised for the coming general meeting of the Society of Naval Architects and Marine Engineers, to be held in New York, November 16 and 17, 1905. The list is not yet complete, and it will be noticed that two of the papers mentioned have not yet been outlined. The list, as it stands at the present time, is as follows:

1. Investigations Relating to the Action of Screw Propellers. By Professor Wm. F. Durand, Member of Council.
2. Progressive Speed Trials of Gasoline Launch Ludo. By George Crouse Cook, Member.
3. Some Results of Tests of Model Propellers. By Messrs. A. V. Curtis and L. F. Hewins, Juniors.
4. Experiments with Ventilating Fans and Pipes. By Naval Constructor D. W. Taylor, U. S. N., Member of Council.
5. Notes on the Strength of Water-tight Bulkheads for Battleships and Cruisers. By Harold F. Norton, Associate.
6. A Tale from Japan. By Mr. George W. Dickie, Member of Council.
7. Marine Steam Turbine Developments. By Mr. E. M. Speakman, Associate.
8. Some Problems in Ferry Boat Propulsion. By Colonel E. A. Stevens, Vice-President.
9. The Ultima, a Globuloid Naval Battery. By Anson Phelps Stokes, Associate.
10. The Cruiser. By Commander Wm. Hovgaard, Member.
11. Scantling Regulation in Yachting. By W. P. Stephens, Associate.
12. Some Notes on Steam Boiler Troubles. By Horace See, Member of Council.
13. Yacht Races. By Paul Eve Stevenson, Esq.
14. Shipbuilding of the Great Lakes. By W. I. Babcock, Member of Council.
15. ————————————. By Clinton H. Crane, Associate.
16. Marine Turbines. By Charles G. Curtis, Member.
17. ————————————. By Naval Constructor H. G. Gillmor, Member.



THE MISSISSIPPI ENTERS THE DELAWARE.

(Photo. W. H. Rau.)

ANOTHER BATTLESHIP LAUNCHED.

On September 30, the new battleship *Mississippi* was launched from the yard of the William Cramp & Sons Ship and Engine Building Company, of Philadelphia. The launching ceremony was performed by Miss Mabel Clare Money, daughter of United States Senator H. D. Money, of Mississippi.

The *Mississippi* is one of two sister ships, the other being the *Idaho*, authorized by act of Congress approved March 3, 1903, and

is the result of a compromise; one party in Congress was in favor of building 16,000-ton ships, while another party favored smaller ships, of a displacement not to exceed 12,000 tons. The compromise was effected by the authorization of three ships of 16,000 tons, now known as the *Minnesota, Vermont,* and *Kansas*, all three of which have been launched, and two of 13,000-tons, of which the present is one. The contract for the construction of the *Mississippi* was signed January 25, 1904, the price for hull and machinery being $2,999,500, and the contract date of completion March 25, 1907, this being thirty-eight months from date of contract. The keel was laid May 12, 1904, so that a period of sixteen months and eighteen days has elapsed between laying the keel and putting the ship into the water. According to the monthly report from the Bureau of Construction and Repair, the *Mississippi* has now reached a stage of completion represented by about 43 percent.

The ship has a water-line length of 375 feet, a beam of 77 feet, and a normal draft of 24 feet 8 inches, the length over all being 382 feet. The displacement on trial, with a load including 600 tons of coal, is to be 13,000 tons, at which the engines, designed to develop 10,000 horsepower, are expected to give a speed of 17 knots. With the full bunker capacity of 1,750 tons of coal and full stores and ammunition on board, the displacement becomes 14,465 tons. The machinery consists of twin-screw, triple-expansion engines, with cylinders measuring respectively 25½, 42 and 69 inches in diameter and a common stroke of 48 inches. These engines are operated by steam furnished by eight Babcock and Wilcox boilers, with a total grate surface of 768 square feet and heating surface of 32,640 square feet, this giving a ratio of 42.5 to 1. The estimated steaming radius at ten knots is 5,750 nautical miles.

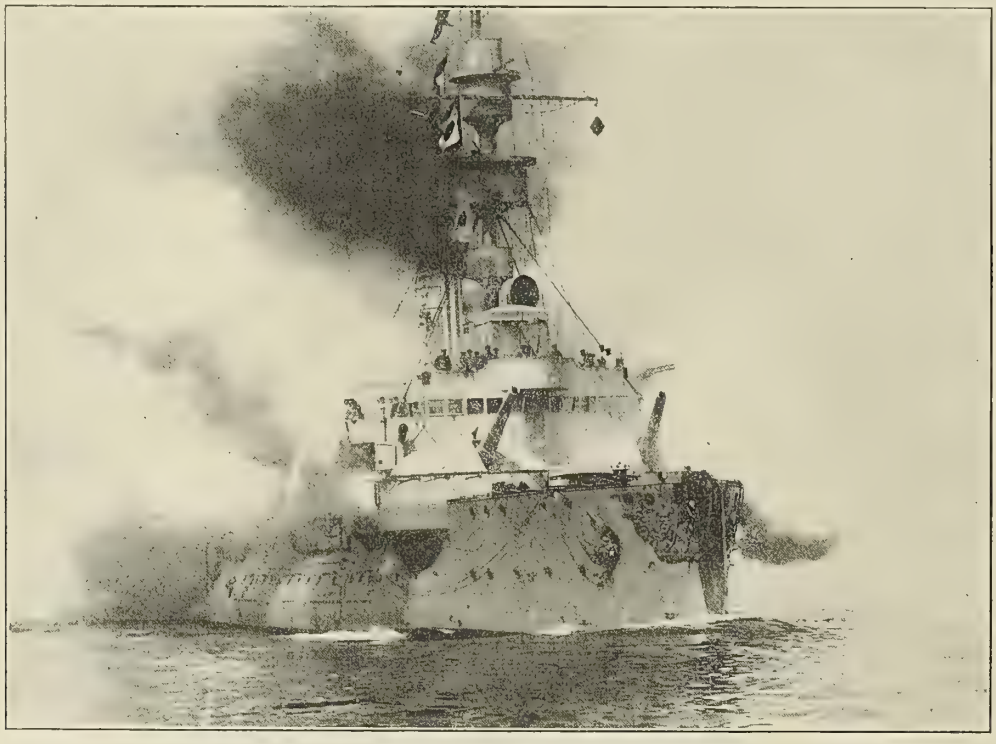
The *Mississippi* is one of the most powerfully armed battleships afloat, and is without exception the most powerful of her size. The main battery consists in four 12-inch and eight 8-inch breech-loading rifles, mounted in pairs in six turrets; the 12-inch guns being on the center line forward and aft, and the 8-inch guns at the four corners of the citadel on the main deck. In addition to these, there are eight 7-inch rapid-fire guns mounted behind 7-inch armor on the broadside, and a secondary battery consisting of twelve 3-inch, six 3-pounder, four 1-pounder rapid-fire guns, two 3-inch field guns, and eight automatic machine guns, together with two 18-inch torpedo tubes of the submerged type.

The protection includes a complete water-line belt, having a thickness amidships of 9 inches and tapering to 4 inches at the ends. The turrets for the 12-inch guns have a thickness on the exposed side of 12 inches and on the rear of 8 inches, while the corresponding thicknesses of the 8-inch turrets are 6½ and 6 inches. The barbettes for the heavy guns are 10 inches on the exposed side and 7½ in the rear, with corresponding figures for the 8-inch guns of 6 and 4 inches. A complete protective deck is fitted, measuring 1½ inches on the flat and 3 inches on the slopes. The crew will consist of 34 officers and 691 men.

German Coast Defense Ships.

We are presenting a reproduction of a photograph showing one of the German armored coast-defense ships of the *Siegfried* class in the act of thundering a salute. It will be noticed that the powder used is not of the smokeless variety.

The *Siegfried* belongs to a class of eight ships, the first of which was launched in 1889, and the last in 1893. These ships were all rebuilt three or four years ago and in process of rebuilding were lengthened. The original dimensions were 239 feet in length, 49 feet in beam, and 18 feet draft, giving a displacement of 3,496 tons, the block coefficient being 0.581. The new dimensions are 254 feet in length, with the same beam of 49 feet, and a draft of 18 feet 3 inches. This gives a displacement of 3,876 tons with a block coefficient of 0.588. The increase in size has enabled the ships to carry 500 tons of coal, as against 225 tons under the original form, has slightly increased the speed, and has admitted a slight increase in the battery. The offensive power is furnished by three 24-centimeter (9.45-inch) guns, 35 calibers long, mounted in three separate barbettes, of which two are side by side forward, while the third is on the center line aft; ten 8.8-centimeter (3.43-inch) rapid-firing guns, 20 calibers long, in place of eight such guns on the original ships; six smaller guns; and four torpedo tubes, of which one is above water aft, and is protected by armor, while three are submerged, one being under the bow and one on each side.



THE SIEGFRIED FIRING A SALUTE.
(Photograph, George P. Hall & Son.)

The designed power of the original ships was 4,800 I. H. P. with a speed of 15 knots. This was furnished by two sets of triple-expansion engines operating twin screws and supplied with steam from cylindrical boilers. Since reconstruction one of the ships, the *Hagen*, has developed 5,235 horsepower on trial with a speed of 15.1 knots at 142 revolutions per minute. The steaming radius figures out at 3,500 miles, at a speed of 10 knots, while the tactical turning diameter, at a speed of 12 knots, proves to be 400 meters, or 432 yards.

The ships are furnished with compound armor, having an armor belt about 7 feet wide with a maximum thickness amidships of 9.45 inches, which is diminished at the ends to 6 inches. There is a flat armored deck having a thickness of 1.2 inches, while the barbettes for the heavy guns and the hoods for the guns are respectively 7.9 inches and 5.3 inches thick.

The eight ships of the class are named as follows: *Siegfried, Hagen, Beowulf, Frithjof, Heimdall, Odin, Ægir,* and *Hildebrand.*

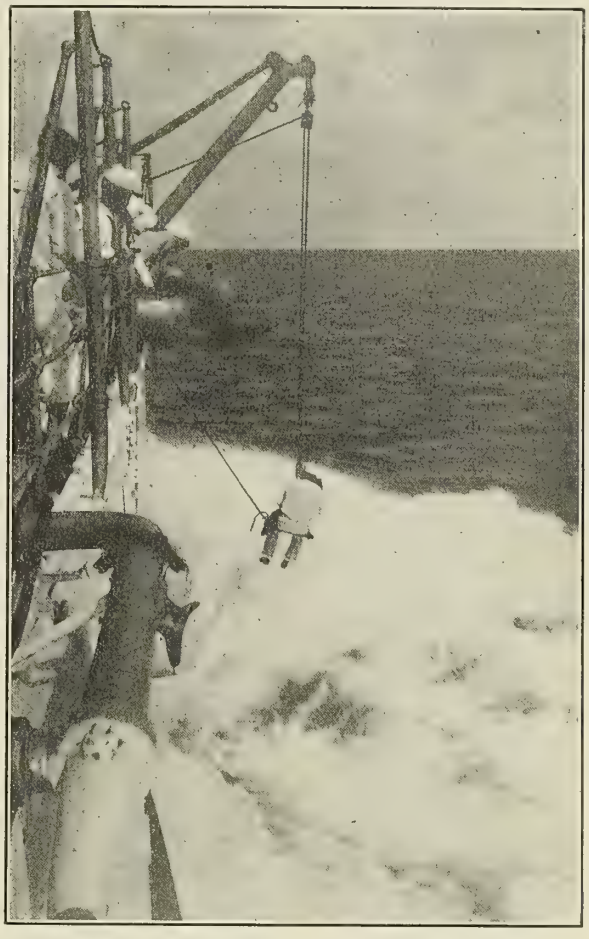
Service Speed Trial of Battleship Ohio.

On July 30, 1905, the first-class battleship *Ohio,* which is attached to the Asiatic squadron, was given a natural-draft speed trial, lasting from 1 to 5 o'clock in the afternoon, during which the speed realized averaged 16.8 knots by patent log, 16.6 knots by observations of positions of ship at beginning and end, and 17 knots as computed from the speed-power curve of the ship. This was the regular quarterly trial called for by the navy regulations, but was at the same time a race in which the battleships *Wisconsin* and *Oregon* were also involved. The *Ohio* is said to have been sixteen miles ahead of the *Wisconsin* at the finish, while the *Oregon* was out of sight in the rear. The Pocahontas coal used was reported to be of good quality, but as a matter of fact it was mostly slack, due to a low supply. The blowers were run simply for ventilating purposes, and at a very low rate of revolution. It is thought that had the coal been really of first quality, and the blowers run to their full capacity, the result would have exceeded in speed that obtained upon the builders' trial trip, namely, 17.83 knots. The mean depth of water varied from 15 to 38 fathoms.

During the trial a number of photographs were taken, and especially interesting is one which we publish, showing a man in the act of taking a photograph of the bow wave while being himself suspended with his camera from the starboard anchor crane.

Trial data follow:

		STARBOARD	PORT
Steam at boilers		186	
Steam at engines		183	
Steam at first receiver	pounds	78	83
Steam at second receiver	pounds	28.8	30.0
Vacuum	inches	24.8	25.6
Cut-off		Full	Full
Throttle		Wide	Wide
Mean effective pressure	H.P.	66.7	55.5
	I.P.	37.1	35.9
	F.L.P.	14.0	14.3
	A.L.P.	13.5	14.7
Revolutions per minute		115.7	115.5
Indicated horsepower	H.P.	1,808.67	1,506.94
	I.P.	2,252.14	2,204.96
	F.L.P.	1,218.85	1,243.16
	A.L.P.	1,155.86	1,278.56
	Total,	6,435.52	6,233.62
Total horsepower main engines		12,670.	
Auxiliaries' horsepower	estimated	280.	
Collective indicated horsepower		12,950.	
Square feet heating surface		53,253.	
Square feet grate surface		924.	
Indicated horsepower per square foot grate surface		14.01	
Square feet heating surface per indicated horsepower		4.11	
Coal per hour	pounds	21,760.	
Coal per indicated horsepower per hour	pounds	1.68	
Pounds coal per square foot grate surface		23.5	
Temperature of engine room	degrees	98.	
Temperature of fire room	degrees	120.	
Temperature injection water	degrees	75.	
Temperature discharge water	degrees	122.	
Temperature feed water	degrees	166.	
Draft forward		24′ 6″	
Draft aft		24′ 2″	
Mean draft		24′ 4″	
Displacement corresponding to mean draft	tons	13,000.	



PHOTOGRAPHING THE BOW WAVE OF THE OHIO.

The Bureau of Navigation, of the Department of Commerce and Labor, reports that there were built in the United States during the quarter ended September 30, 1905, 315 ships of a total of 82,520 tons. Of this total 31 ships of 68,880 tons were built of steel and the balance of wood. Of the steel ships 27, of 66,329 tons, are propelled by steam. In the latter class are 14 ships on the Great Lakes, aggregating 54,845 tons, or about two-thirds of the grand total of all ships built during the quarter. The total compares with 328 vessels, of an aggregate of 40,374 gross tons, built during the corresponding quarter of 1904.

Lloyd's Register reports under construction in the United Kingdom on September 30, 1905, a total of 474 merchant ships of an aggregate of 1,325,328 gross tons, of which 446 of 1,320,098 tons are propelled by steam and the balance by sail; in the former class all but two ships are of steel. These figures compare with a total of 393 ships of 1,046,308 tons on the same date one year ago. Of the ships included in the above totals, no less than eleven are of 10,000 tons and upward, of which five reach 20,000 tons and three others 15,000 tons.

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Notice to Advertisers.

Changes to be made in copy, or in orders for advertisements, must be in our hands not later than the 15th of the month, to insure the carrying out of such instructions in the issue of the month following.

The edition of the November issue of Marine Engineering comprises 5,500 copies. We have no free list, accept no return copies and issue only enough to supply the regular demand, so that the 5,500 copies represent legitimate circulation.

We have now no engineer corps, though we used to have the best in the world.—Melville.

The Merchant Marine.

We publish in another column a masterly dissertation on the subject of the American Merchant Marine from the lips of Mr. George W. Dickie, late manager of the Union Iron Works of San Francisco. This address was delivered during the exposition in Portland, Ore., and gives a splendid idea of the difficulties with which American shipbuilders have to contend in competing with those across the water. The table presented, showing differences in cost of labor between the Union Iron Works and a dozen representative yards in Great Britain, illustrates the great controlling factor in the problem, speaks volumes for the tremendous handicap endured by our shipbuilders, and makes it plain why we have been able to do so little in the matter of building up our merchant marine. It is a fact that since the contracts were let for the construction of the Great Northern steamships *Minnesota* and *Dakota*, which occurred in June, 1901, there has not been obtained by any American shipbuilder an order for any merchant ship of any importance for use in trans-oceanic trade, except as between non-contiguous parts of the United States. In direct contrast with this state of affairs, it may be stated that during the month of September shipbuilders on the Clyde alone booked orders for 100,000 tons of shipping, while 40,000 tons of new ships intended almost entirely for foreign service were launched during that month. During the quarter ending September 30, 1905, the merchant shipping placed under construction in the United Kingdom amounted to about 374,000 tons, while there were launched during the same period ships aggregating 419,000 tons. Another indication of the tremendous decadence of our shipping is evidenced by the fact that during the first week in October there arrived in the port of New York thirty-five steamers from Great Britain and the mainland of Europe, only one of which was under the Stars and Stripes. Of the remainder, fifteen were British, six German, four Italian, three French, two Danish, and one each from Norway, Holland, Portugal, and Austria-Hungary. There is not a single one of these nations which has so great an export trade of domestic products as has the United States, and, with the sole exception of Great Britain and Germany, not one has so large an import trade; and yet with an enormously smaller volume of business to be transacted, these other nations are able to send into the chief port of the United States ships in much larger number than those which the United States can maintain, and thereby take care of upward of ninety percent of our ocean-going commerce.

There is nothing in the shipbuilding art itself which would make it of necessity a non-paying industry; and when it is removed from competition with inferior conditions of labor, as is the case with our shipbuilding on the Great Lakes, large profits are obtained. The annual report of the American Shipbuilding Company shows that during the year ending June 30, 1905, the net earnings of this corporation, after deducting all operating expenses from gross earnings, amounted to $1,550,000. Deductions for depreciation and maintenance of plants and rebuilding in a number of cases reduced the figure to about $1,200,000, which was thereby made available for dividends. After these dividends had been paid, there remained a surplus for the year of $640,000. This was added to a previous surplus of $3,680,000, giving a total surplus at the present time of more than $4,300,000. This is pretty good evidence of a healthy condition, and a condition which could be reasonably expected to obtain upon the Atlantic and Pacific seaboards, were it possible to withdraw the industry on those coasts from direct competition with the cheap labor of Europe. It is beyond all question that it will be utterly impossible for us to meet that labor in kind by debasing the condition of American labor to that represented by the wages received on the other side of the water; and the only alternative, if we are to build ships for foreign service, is to make some provision, whether by subsidy or otherwise is immaterial, looking to the protection of that industry in the same manner and in the same degree as nearly all other industries in the United States are protected. Theorists may differ on the general value of protection from the point of view of political economy, when considered in the abstract, but there can be no difference of opinion whatsoever upon a

subject such as the present, where it is found that protection for internal industries has resulted in raising prices of labor and improving conditions of living to such an extent as to make it impossible to continue a single industry *outside the barrier of the protective tariff* with any chance of making it a profitable undertaking.

At the thirty-first annual meeting of the American Bankers' Association, which was held in Washington during the month of October, Hon. Leslie M. Shaw, Secretary of the Treasury, addressed the association upon this subject, and we quote as follows from his address:

"We point with pride to our export trade of a billion and a half, and with our thumbs in the armholes of our waistcoats we contemplate our skill and foresight and our ability as international merchants. Will I be pardoned if I suggest that this export trade is due in no very large degree to our skill either as international bankers or as international merchants?

"Of our aggregate exports, about $1,000,000,000 consists of raw cotton, food products, petroleum products, crude copper, lumber and other raw materials and crude articles, of which we produce a surplus which the world not only needs but must have.

"The time is coming, gentlemen—with our increasing population more largely urban than ever, with factories multiplying more rapidly than farms, with limitless manufacturing resources and matchless aptitude for production—when the United States will need new and important markets. The world may come to us in its own ships for the products of our farms and the raw products of our mines, but it will not come in its own ships for the finished products of our factories. The time is coming when we will need international bankers and international merchants and an international merchant marine.

"I am well aware that this is not supposed to be a popular theme, but I did not accept your courteous invitation for the purpose of discussing subjects on which all good men agree. I accepted for the purpose of bringing to your consideration questions which public speakers usually avoid, to the end that you may think them over, talk them over by your firesides and in your places of business, in the hope that we may some time, and as soon as possible, agree upon some course, some policy, that will restore our flag to her deserved place on the seas and give to American enterprise its share of the carrying trade of the world.

"We occupy the best position on the map. We have the safest and most convenient form of money in the world. We speak the language of commerce. Our farms produce more than the farms of any other country. Our mines yield gold literally by the car-load, silver by the train-load, and there is unloaded on the shores of a single commonwealth more iron ore than any other country produces. Our forests yield one hundred million feet of lumber for every day of the calendar year. Our factories turn out more finished products than all the factories of Great Britain and Germany combined by more than three thousand millions every twelve months. We transport this matchless product of farm and factory, forest and mine, from the interior to the sea at one-third what similar services cost anywhere else beneath the skies. We carry it from point to point along the coast in better vessels, on quicker time, and at cheaper rates than others.

"But at our coast line we are brought to an abrupt halt. Here we are no longer independent. Our foreign commerce is four times as large as forty years ago, but we carry in our own ships only one-third as many gross tons as forty years ago. We have protected and encouraged every interest but our merchant marine, and every protected interest has flourished. We have every facility for international commerce except international merchants, international bankers, and an international merchant marine. Shall we not have these? I am not urging ship subsidies. I am speaking of results, not of methods. If we will but take advantage of our opportunities we will send these products of farm and factory under every sky and into every port, and make our financial centers the clearing houses of at least a fraction of the world's trade."

At the conclusion of the meeting the twenty-five hundred bankers in attendance passed a resolution introduced by Colonel Robert J. Lowry, of Atlanta, Ga., which read as follows:

"Resolved, That the members of the association are deeply interested in any measure which will promote the interests of the whole country, industrially and commercially, and especially with reference to our foreign commerce.

"That we favor and most respectfully urge the passage by congress of some measure to foster and encourage the upbuilding of the merchant marine and give us back the prestige on the high seas which we once enjoyed.

"That we favor the ship subsidy measure, which has received consideration at the hands of our congress, and which we think would tend to restore our flag upon the seas and build up our merchant marine to the extent that the necessities of our trade now and in the future may demand.

"That we recommend that our senators and representatives favor some just and equitable measure that will bring about the results and afford the relief above suggested.

"That through our legislative committee we memorialize the senate and house of representatives of the United States with a copy of these resolutions."

This, taken in connection with similar action by other associations in the recent past, shows the growing conviction which we mentioned above, and as the movement seems to be spreading all over the country, and to be confined to no one section, not even to the seaboard section, it seems as if some action by congress could reasonably be expected at an early date. It is certainly a question which demands settlement without further delay, and one which demands very earnest attention at the hands of those who are charged with its settlement. We recommend to congress a careful consideration of the condition of the American merchant marine, and of the position of the shipbuilders who are so situated as to be in direct competition with those of Europe.

ABSTRACTS FROM RULES AND REGULATIONS OF THE GREAT LAKES REGISTER.

EDITION OF 1904.

ARRANGED BY HARRISON S. TAFT.

PART I.

1. Measurements.

1. Length. L. From the forward side of the stem to the after side of the stern post, measured on a water-line calculated at 2 1-2 inches of freeboard for every foot molded depth of hold.

2. Breadth. B. Maximum molded beam.

3. Depth. D. From the upper side of the garboard strake to the top of the upper deck beams at center line amidships.

In awning-deck vessels the depth is to be measured to the under side of the deck next below said awning deck at center line amidships; but as stated in the preceding paragraph in determining the equipment number.

4. Scantlings Determined by Length and Depth.

Bar keels; stems; stern posts; flat plate keels; shell plating; frame spacing; rudder post and pintles; keelsons; keelson angles; bulkheads; ceilings; deck stringers; tie plates; deck plating; and stringer angle bars.

5. Scantlings Determined by the Formula: $B + D$.

Frames; reverse bars; floors; stanchions in connection with their length.

6. Scantlings Determined by Length of Vessel.

(*a*) The center vertical keelson, tank-top plating, side keelsons and keelson angle bars of double-bottom vessels.

(*b*) The side plating, deck stringers, tie plates, bulkhead plating and stringer angle bars of a poop, raised forecastle, quarter or awning deck.

7. Scantlings of beams is determined by the length of midship beams.

8. Equipment Number.

$$\frac{L \times B \times D}{125} + 80 \text{ per cent. of the capacity of all deck erections.}$$

2. Scarphs.

Scarphs of all bar keels, stems, and stern posts, should be in length not less than three and one-half times the depth of the bar keel.

3. Stems.

1. Stems are to be of the same scantling as the bar keels. They should maintain their full sectional area up to the load water-line, with a reduction to 3-4 of said area at their heads.

2. When worked with a flat plate keel the lower part should taper so as to be, at its extreme end, of the same thickness as the keel butt straps; and of the same width as the keel liners.

4. Stern Frames.

1. Stern frames in all vessels—except single-screw vessels—are to be of the same scantling as the bar keels. Those of single-screw vessels are to be of the same depth as the bar keels, but of increased width. There shall be a solid boss at the heel of the stern post to receive the foot pintle of the rudder.

2. Stern frames may be gradually reduced in sectional area above the counter, but said reduction must not exceed 1-4 of the full sectional area of the stern frame.

3. In sailing vessels and tow barges, that part of the stern frame forming the keel should extend forward of the vertical post at least 5 feet when the depth of hold is 12 feet and under; but 6 feet when said depth is above 12 feet. In single-screw vessels, it must extend forward at least 6 feet; with the foot knee extending at least four frame spaces when the tabulated depth of hold is over 12 feet.

4. That part of the shoe which is directly below the propeller is to at least equal the sectional area of the tabulated propeller post.

5. The sectional area on each side of the propeller boss shall be at least 65 per cent. of the tabulated section.

6. When worked with a flat plate keel the part extending forward of the vertical post should taper so as to be, at its extreme end, of the same thickness as the keel butt straps, and at least of the same width as the sum of the two keel angles plus the thickness of the vertical center keelson.

7. Gudgeons on the stern posts and rudders must not be spaced more than five feet apart.

5. Keels and Center Line Keelsons.

1. Center Vertical Plate Keels (single-bottom vessels).

(*a*) The depth of such keels is to at least equal the depth of midship floors plus the depth of the tabulated bar keel. Side plates, of the same depth as said bar keel, shall be worked on each side of the vertical plate keel below the floors; the thickness of said side plates being such as to render the combined thickness of the vertical plate keelson and the side plates the same as that of said bar keel. The side plates may be dispensed with if the vertical plate keel and garboard plates are all increased so that their combined thickness will be equal to that of the tabulated bar keel plus the garboard plates. The butts of the vertical keel and side plates must be well shifted from those of the garboard strakes.

(*b*) The top of said vertical plate keel must extend above the top of floors so as to be connected to a horizontal plate stringer of the same thickness as the garboards, worked on top of floors on each side of the vertical keel, by two continuous angle bars riveted back to back, embracing the upper edge of said vertical plate keel.

(*c*) 1. The vertical plate keel may extend above top of floors a sufficient height so as to allow of two top angles (and a rider plate if desired) besides the two above angle bars on top of floors; the above horizontal plate stringers being omitted. The four angles and that part of the vertical plate keel extending above the floors need not extend beyond the collision bulkheads; a flat horizontal plate being worked at center line in the fore-and-aft peaks, connecting the top of floors.

2. For 1-8 of the vessel's length at each end the angle bars may be reduced in scantling. In the machinery space the girder section is to be increased by 12 1-2 per cent. over the midship section of said girder.

2. Center Line Girder on Top of Floors (single-bottom vessels).

(*a*) Said girder is to have two top angles with a rider plate, and be secured to a horizontal plate stringer on top of floors by two continuous angle bars, riveted back to back, embracing said girder plate.

(*b*) Said girder is to extend from the forward to the aft collision bulkhead; intercostal plates with a top horizontal stringer plate being worked in the two peaks at the center line.

(*c*) The girder section may gradually be reduced by 12 per cent. for 1-8 length at each end, except in the machinery space, where it must be made 12 per cent. larger than the midship section.

3. Flat Plate Keels.

(*a*) They should maintain their midship scantling for 1-2 length amidships. No reduction from midship thickness will be allowed at the after end in screw steamers.

(*b*) They are to be connected to a continuous or intercostal vertical keelson by continuous or intercostal double angle bars respectively.

4. Intercostal Center Line Keelson (single-bottom vessels).

(*a*) When worked with a flat plate keel it should extend above top of floors according to requirements; with double angle bars or bulb angles on top of floors riveted back to back embracing the top edge of said keelson.

(*b*) A horizontal plate stringer may be worked on top of floors in connection with said bars, as stated in 5-1-*b*; each plate stringer being equal to the depth of midship floors.

6. Frames.

1. Frames are to maintain their midship scantling for 2-3 length amidships. Frames in the machinery space are to be of midship scantling. In the after end of steamers the frames must be of midship scantling. When the speed is 14 miles and above double angle bar stringers fitted with intercostal plates to the shell must be worked abaft the aft collision bulkhead.

2. All frames are to extend to the upper deck stringer plates. In way of an awning, a raised forecastle, poop or quarter deck, they are all to extend to the stringer plates of said decks.

3. With rounded gunwales the frames are to extend to the lower part of said gunwale; the beams being turned down at their ends and securely fastened to the top of the frames.

4. Intermediate frames, extending to the second deck in two-deck vessels and above the deep load water-line in single-deck vessels, are to be worked forward of the forward collision bulkhead.

5. The lower part of frames at extreme ends of ships should lap and be riveted to each other.

6. Frames at all collision bulkheads are to be worked double. Single frame bars may be fitted at all other watertight bulkheads, provided the standing flange is of sufficient size to permit of double riveting the same to the bulkhead plating.

7. Scarph pieces must be used at the center line butts of frames except when a continuous center line keelson is worked. They are to be of the same scantling as the frames and be long enough to take three rivets, spaced 6 inches apart, on each side of said butts.

7. Floor Plates.

DOUBLE-BOTTOM VESSELS.

1. A floor plate is to be fitted to every frame. They are to maintain their midship scantling for 2-3 length amidships, but no reduction will be allowed in the after end of screw vessels. Floors at extreme ends of ship must be increased in depth.

2. In sailing vessels and tow barges the weight of midship floors is to extend for 1-2 the vessel's length amidships, with a gradual reduction at the ends.

3. In steamers with machinery located aft, the floor plates from the forward collision bulkhead aft to the foremost floor of the engine and boiler space are to be of midship scantling.

4. All floors are to be secured to a center line vertical keelson with double clips of specified size for 2-3 length amidships including the machinery space. The double clips forward and aft of said 2-3 length are to be of the same scantling as the reverse bars.

5. All floors in the machinery space are to be 12 per cent.—those directly under the boiler beams 20 per cent.—heavier than midship floors; all of said floors being of the "solid plate manhole" type. When the boilers are located on the second or main deck, or on a specially built boiler deck, the above increase in weight of floors under the boilers may be dispensed with. Floors under said boiler deck must be strengthened in way of the quarter stanchions to said deck.

6. Bulkhead floor plates should be 10 per cent. heavier than other floors.

7. Floor plates of the collision bulkheads should be made deeper than other floors so as to permit the bulkhead plating being riveted to same above the tank top bounding angle bar.

8. A deep divisional floor should be worked under all hold bulkheads.

9. In single-bottom vessels the depth of floors must be 20 per cent. deeper than in double-bottom vessels.

10. Limber holes must be cut in all floors so as to provide a free flow for the bilge water to the pump. In double-bottom vessels the holes should be two inches in diameter.

11. Transom Floors. They are to be of the same weight as the midship floors but twice their depth at center line.

8. Reverse Bars.

1. A reverse bar must be fitted to every frame when the ordinary angle bar frame is used. They are to maintain their midship scantling for 2-3 length amidships, but no reduction will be allowed in the after end of screw steamers.

2. Double reverse bars are to be fitted on every floor in the way of the engine, but on alternate frames in the boiler space. Said doubling bars are to extend from bilge to bilge and be secured to the frames at the upper turn of the bilge. When the boilers are located on a special built boiler deck or on the main deck single reverse bars may be used in way of same.

3. When worked in connection with angle bar frames the reverse bars are to extend to the second and upper decks alternately. When the frame spacing is 24 inches, in way of a raised fore, a raised quarter, or poop deck, the combined length of which equals 1-2 the vessel's length, within said structures the reverse bars are to be fitted to alternate frames, and extend to said deck stringers.

4. In awning-deck vessels the reverse bars are to extend to the deck next below said awning deck on every frame and alternately to the awning deck in way of any erections upon said deck.

5. In spar-deck vessels the reverse bars are to extend to the upper and second decks alternately.

6. In way of a raised forecastle deck the reverse bars are to extend to said deck on alternate frames.

7. In sailing vessels, when the sum of their breadth and depth exceeds 60, the reverse bars are to extend to the upper deck on every frame.

8. In steamers, when the sum of the breadth and depth to the upper deck exceeds 35, the reverse bars in way of the machinery space and paddle boxes of side-wheel steamers are to extend to the upper deck on every frame. Web frames may be fitted in lieu of said reverse bars.

9. Bilge and Floor Keelsons. Side Stringers.

TABLE I.—BILGE AND FLOOR KEELSONS.

Depth in Feet.	Bilge Keelsons.		Floor Keelsons.
	Upper.	Lower.	
14 under 18	D A	.....	D A
18 " 26	D A	D A + I P ½ L	D A
26 " 30	D A + I P ½ L	D A + I P ½ L	D B A + I P ½ L
30 " 36	D A + I P T	D A + I P T	[a] D B A + I P T

[a] Two such keelsons to be fitted on each side.
Depth to be measured as per Section 1.
D A = double angles. D B A = double bulb angles.
I P ½ L = intercostal plates for ½ length amidships.
I P T = intercostal plates throughout.
Said bilge keelsons are to extend from peak to peak.
This table applies to single bottom vessels only

1. The clips connecting the intercostal plates to the floors and to the shell plating shall be of reverse bar size.

2. All intercostal plates and keelson angle bars are to be 10 per cent. heavier than otherwise in the boiler and engine space.

3. The floor and bilge keelsons should when possible terminate forward in a breast hook properly secured to the shell plating.

4. The breast hooks should not be more than 4 feet apart and should extend from the windlass deck to the peak floors. Similar breast hooks are to be worked aft.

5. There shall also be a panting stringer of the same section as the floor side keelsons, extending from the stem aft for 1-8 of the vessel's length, being secured to the reverse frames and reverse clips by four rivets at each frame. Where necessary said stringer should be chocked to the shell. Panting beams may also be fitted in the fore peak in connection with said stringer.

6. Side or Hold Stringers. See also Table 3.

(*a*) Plate side stringers are to be joggled around the frames and be connected to the shell plating by intercostal clips. They may be worked continuously or be cut at a web frame, but must be firmly secured to same. The butts are to be well shifted from the butts of the shell strakes in way of said stringers.

(*b*) Bracket plates are to be fitted at alternate frames so as to properly support the stringer plates.

(*c*) A continuous angle bar should be worked at the face of the reverse frames, and on the inboard edge of the stringer plates.

(*d*) When channel web frames are adopted channel stringers in connection with channel or "Z" bar intercostal chocks may be used. Said channel bar stringers should be connected to all web frames by double angle clips and a diamond plate.

(*e*) When the tabulated depth of a hold stringer exceeds the depth of a web frame, the depth of said web frame in way of same should be increased to that of the stringer with a diamond plate connection at the junction of the stringer and web; or else bracket plates must be fitted at the web frame both above and below the

stringer. The stringer may be reduced to the depth of the web if the tabulated sectional area is maintained or additional stringers worked.

(*f*) When the distance between decks or stringers exceeds 8 feet additional strength must be provided.

10. Floor Clips.

Angle clips of reverse bar size are to be worked on all floors and frames in way of all angle bar and plate stringers.

11. Continuity of Stringers.

1. All hold and beam stringers, floor and bilge keelsons must be worked continuously through all bulkheads except the fore-and-aft collision bulkheads, to which they may be secured by bracket plates and angle clips.

2. Scarph or bosom pieces should be fitted at the butts of all continuous angle bar, bulb angle and channel stringers.

12. Web Frames.

TABLE 2.—WEB FRAMES.

Depth of Vessel in Feet.	Channel.		Plate.		Diamond Plates.	
	Ins.	Lbs.	Ins.	Lbs.	Ins.	Lbs.
14 to 16	12	20	12	12½	18 × 18	15
17 " 19	12	25	13	12½	19 × 19	15
20 " 22	12	30	14	15	21 × 21	17
23	12	30	15	16	22 × 22	18
24 to 26	15	33	15	16	22 × 22	18
27	15	33	16	17½	24 × 24	20
28	15	35	16	17½	24 × 24	20
29	15	35	17	17½	25 × 25	20
30	15	40	17	17½	25 × 25	20
31 and 32	15	40	18	18½	27 × 27	21
33 " 34	17	45	19	18½	28 × 28	21
35 " 36	20	50	20	20	30 × 30	22½

Depth measured from top of floors to upper deck at center line amidships.

1. A web frame must be fitted at each side of a cargo gangway when same is located on the second deck.
2. When the deck height exceeds 8 feet, extra compensation in the way of web frames will be required.
3. Web frames are to be fitted in the machinery space in lieu of lower deck or hold beams.
4. Web frames of surpressed decks are to extend from the floors or tank top to the upper deck (not awning deck) and be connected to the margin plate and upper deck beams by efficient bracket plates.
5. For Spacing of Web Frames See Table 3.

13. Deck and Hold Beams.

1. Deck and hold beams should be located vertically over each other. Those of the upper deck, raised forecastle, poop, awning and quarter decks, and the short beams in way of deck openings, must be fitted to alternate frames.

2. The fore-and-afters at all deck openings should be of the same scantling as the end beams to which they are attached.

3. The short beams at wide hatches may be reduced by 10 per cent. from the tabulated size.

4. Box beams, when used, should be one frame space wide; being built of two beams on adjacent frames

TABLE 3.—ARRANGEMENT OF DECK BEAMS; WEB FRAMES; AND HOLD STRINGERS.

Type.	Hold Beams and Hold Stringers.			Web Frames in Lieu of Hold Beams.				Hold Beams and Web Frames when no Lower Decks are Laid.			
	Depth in Feet.	Spacing of Hold Beams.	Type of Hold Stringer.	Depth in Feet.	Spacing of Web Frames.	Spacing of Hold Beams.	Type of Hold Stringer.	Depth in Feet.	Spacing of Web Frames.	Spacing of Hold Beams.	Type of Hold Stringer.
One deck vessels.	14	12 Fr.	....	14	12 Fr.	....	Plate.	14	12 Fr.	....	Plate.
	15 and 16	8 "	....	15 and 16	8 "	....	"	15 and 16	8 "	....	"
	17 " 18	6 "	D A	17 " 18	8 "	....	a. "	17 " 18	8 "	....	a. "
	19 " 20	4 "	Plate	19 " 20	6 "	....	a. "	19 " 20	6 "	....	a. "
	21	Alt. "	"	....	....	....	....	21 to 23	6 "	6 Fr.	"
	....	....	....	....	....	....	....	24	4 "	4 "	"
	....	...	....	....	....	....	....	25 to 30	4 "	4 "	a. "
Two-deck vessels.	22 to 24	12 Fr.	....	21	— Fr.	....	Plate.	31 and 32	4 Fr.	....	a. Plate
	25 and 26	8 "	Plate	22 to 24	12 "	....	"	34 to 36	4 "	12 Fr	"
	27 " 28	6 "	"	25 and 26	8 "	....	a. "	....	....	....	...
	29	4 "	"	27 to 29	6 "	....	a. "	....	....	....	...
	30 to 32	Alt. "	....	30	4 "		a. "	....	....	....	....
	....	....	....	31 and 32	4 "	12 Fr.	"	....	....	....	....
	....	....	....	34 to 36	4 "	8 "	"	....	....	....	...
A	34 to 36	12 Fr.	....	....	....	....	....	....	....	....	....

A = three deck vessels. a. Two hold stringers.
Upper deck beams to be located on alternate frames.
Depth to be taken from top of floors to upper deck at center line amidships.

connected together by a plate on top, and by stays on the underside. Said box beams should have gusset plates at their ends, extending three beam spaces before and abaft of said beam and three feet on the beam itself, being double riveted on both sides.

5. When proper quarter stanchions are fitted, deck beams so supported can be 10 per cent. lighter than otherwise.

6. The vertical spacing of deck beams below the upper deck, in two-, three-, and spar-deck vessels, is to be regulated by the depth from top of floors to the upper deck amidships. In awning-deck vessels the depth is to be taken to the deck next below the awning deck. In double-bottom vessels the depth is to be taken at center line amidships to the under side of said decks.

14. Beam Knees and Brackets.

1. When the knees are of plate, their thickness is to be the same as the web of the beam to which they are attached. Their diagonal edge should be flanged.

2. Plate knees to the upper deck beams are to be on each side three times the depth of said beam, and twice said beam depth across their throat. All other plate knees are to be respectively 2 1-2 and 1 3-4 times the depth of the beam to which they are attached.

3. Welded knees at beam ends should be in depth 2 1-2 times the depth of the beam.

4. (*a*) When fitted to channel beams (in connection with web frames) the knees are to be secured to the lower flange of said beams by an angle clip or by a flanged edge on the bracket plate. These knees are to be in depth twice the depth of the beam they are attached to.

(*b*) When the length of a beam exceeds 44 feet (beams and stanchions being of channel), and no quarter stanchions are worked, similar bracket plates must be fitted to the center line stanchions at both upper and lower decks. When no decking is fitted on the main or lower deck beams, knee brackets should be fitted to both top and bottom of said lower deck beams, securing same to the stanchions.

15. Stanchions.

1. When the beams are spaced more than one frame space apart stanchions should be fitted to every beam. When the beams are spaced on every frame the stanchions should be located under alternate beams, being secured to a continuous fore-and-aft girder under said beams.

2. (*a*) When the tabulated length of a beam is 48 feet or over a row of quarter-stanchions should be worked under the main-deck beams midway between the center line and the side of the ship. Said stanchions are to be in sectional area 2-3 that of the center stanchions and be spaced 8 feet apart.

(*b*) If the quarter stanchions are of the same size and spacing as the center stanchions, said center stanchions may be omitted.

(*c*) In lieu of quarter-stanchions wing stays may be adopted. Said stays being fitted at web frames, extending from the channel tie at hatches to the hold stringer, for 2-3 the vessel's length amidships.

3. When the length of the stanchions exceeds 8 feet they should be connected together by some kind of a tie plate at their half length.

4. Suitable stanchions should be worked under a raised boiler deck, a windlass deck, and all deck winches or other heavy deck weights.

16. Deck Plating, Stringers, and Tie Plates.

1. Deck Plating.

(*a*) In no case is the deck plating at ends to be of less than 10 pounds. Deck plating between hatches should be worked in one length. When a steel deck does not exceed 10 pounds, with beams fitted to alternate frames, and no wooden deck is laid thereupon, stiffening angles shall be worked under each strake of deck plating; the ends of said angles being secured to the deck beams.

(*b*) When the length athwartship of an upper-deck hatch does not exceed 1-3 the vessel's beam, the deck plating between the upper-deck stringers is to be 20 per cent. heavier than otherwise for the 1-2 length amidships.

(*c*) Boiler-deck plating is to be of not less than 17 1-2 pounds. There shall be a plate or flange 12 inches in height at inside of the frames; said deck being made watertight thereat by cement or otherwise.

(*d*) A plate of suitable size to take all holding-down bolts is to be fitted on the under side of the deck beams in way of all windlasses, capstans, and steering engines; also for quarter-blocks and guide sheaves.

(*e*) All steel decks are to be caulked and made watertight, being fitted with suitable drain pipes.

2. Deck Stringers.

(*a*) Said stringers are to maintain their full midship scantling for 1-2 the vessel's length amidships, except in those vessels with their machinery located aft, in which case the full midship weight is to extend forward from after end of the machinery space for 2-3 of the vessel's length.

(*b*) When the athwartship length of an upper-deck hatch is over 1-3 the vessel's beam the stringer plates of said deck are to be heavier than otherwise.

TABLE 4.—WIDTH OF DECK STRINGERS.

Deck.	Athwartship Length of Upper Deck Hatches.	Stringer Width.
Upper deck stringer..	Over ⅓ vessel's beam.....	$\frac{1}{6}$ of vessel's midship beam.
" " " ..	Not over ⅓ vessel's beam.....	$\frac{1}{8}$ " " " "
Second " " ..	.....	$\frac{1}{10}$ " " " "
Third " " ..	.....	$\frac{1}{12}$ " " " "
		$\frac{1}{24}$ " " " "

(*c*) The butts of the upper-deck stringers should be shifted at least two frame spaces from the sheer-strake butts.

(*d*) Stringers are to be worked continuously through all bulkheads except the fore-and-after collision bulkheads, to which they may be bracketed. The bracket plates are to equal the lower plating of collision bulkheads and have a double angle-bar connection to said bulkheads.

(*e*) The ends of the stringers in the end peaks should be strongly fastened together by a breast hook.

(*f*) In steel barges the upper-deck stringers may be 10 per cent. less in weight than specified for steamers.

3. Tie Plates.

(*a*) Tie plates must be fitted on top of the deck beams at ends of all hatches when a wooden deck is laid so as to support the ends of the deck planking. They should also be fitted to the second deck and hold beams when no decking is laid thereupon, being of angle or channel section.

(*b*) All tie plates or angle bars in way of hatch ends are to extend continuously from peak to peak. In the machinery space they can be worked to suit conditions therein.

(*c*) When the length of a vessel is 350 feet or above, especially single-deck bulk freight vessels with large transverse hatches, a fore-and-aft tie of suitable form should be worked continuously in the way of hatch ends on the under side of the upper-deck beams, with intercostal plates or chocks between the beams, so as to stiffen the deck plating.

(*d*) Vessels of 45-foot beam and above, with a wooden deck and small hatches, should have an additional tie plate between the stringer plates and the tie plates at sides of the hatches, with diagonal tie plates between the same.

(*e*) In vessels with large, transverse hatches, tie plates must be worked so as to connect together all the main-deck beams between the hatches. Also the beams of the second and third deck where no decking is laid thereupon.

(*f*) At sides of hatches the tie plates are to be double their ordinary width with a gradual taper beyond the hatch to their regular width.

4. Mast Partners.

(*a*) When no steel deck is laid the mast-partner plates are to be of the same thickness as the deck tie plates. They are to be four frame spaces in length, and in breadth twice the diameter of the mast hole.

(*b*) When a steel deck is laid a suitable doubling plate should be worked at each mast partner. Said plates to cover three beam spaces in a fore-and-aft direction and be in width three times the diameter of the mast hole.

(*c*) A coaming ring of the same size as the keelson bars is to be worked around the mast hole on the upper side of the plating.

17. Bulkheads.

1. A watertight bulkhead shall be located aft of the stem (measured on the load water-line) at a distance equal to one-half of the vessel's beam. There shall also be a watertight bulkhead a sufficient distance forward of the stern post with a doubling plate, of the same weight as the bulkhead plating, at the hole for the stern tube. A watertight bulkhead shall be worked at each end of the machinery space.

2. All watertight bulkheads should extend to the upper deck.

3. All watertight bulkheads are to have double frame angles, or single frame angles double riveted in both flanges, and be connected to the inner-bottom plating by double angles of reverse-bar size.

4. Vertical stiffeners are to be located on the after side of all bulkheads, spaced 30 inches apart; with the horizontal stiffeners worked on the opposite side spaced not over 4 feet apart. Horizontal stiffeners need not be worked above the second deck except on the collision bulkhead.

5. Forward Collision and Other Watertight Bulkheads.

(*a*) When said bulkheads are over 38 feet wide at their widest part a web plate with double-face angles extending from top of floors to the lowest tier of beams, is to be fitted to the center vertical stiffener.

(*b*) When said bulkheads are 40 feet in width, the horizontal stiffeners are to be of increased size.

(*c*) When the width of the widest part is 45 feet and above, a web plate is to be located on each side of the center web plate midway between it and the ship's side. Said side webs are to be similar to the center web.

6. When the height of a watertight bulkhead is 13 feet or over to the second deck (to upper deck in single-deck vessels), bracket plates are to be fitted to both the upper and lower ends of its vertical stiffeners, connecting same to the tank top and deck plating. With a wooden deck a transverse plate should be fitted on the deck beams for securing said brackets to the deck.

7. No opening will be allowed in the collision bulkheads, access to the fore-and-aft peaks being by hatchways and ladders through the decks above same.

8. A watertight door may be worked in the engine-room bulkhead; same to work from the upper deck.

9. Bulkhead liners are to extend from one frame space on each side of the bulkhead frame.

10. The ends of horizontal stiffeners should be connected by bracket plates to the side stringers, being worked in way of same.

11. The fore-and-aft peak bulkheads are to be tested by filling said peaks to the deep load water-line.

12. Coal-Bunker Bulkheads.

(*a*) The plating is to be of the same weight as that of the cargo-hold bulkheads. When of 12 feet or more in depth the horizontal and vertical stiffeners are to be of the same scantling as the reverse bars; when of less than 12 feet in depth the stiffeners may be of a trifle less scantling. The stiffeners are to be spaced as on the cargo-hold bulkheads.

(*b*) When not worked in way of a beam, transverse bulkheads are to be secured to the deck plating by double angle bars. All coal-bunker bulkheads are to have a double angle-bar connection to the tank-top plating.

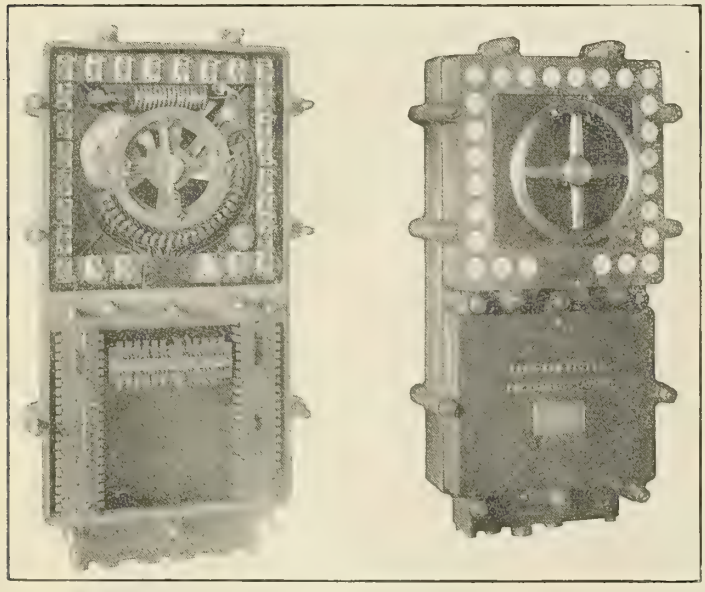
(*To be continued.*)

ENGINEERING SPECIALTIES.

An Ingenious Piece of Electrical Mechanism.

On all the new warships of the navy there is installed what is known as the "Long-Arm" system of electrically-operated bulkhead doors and hatches. The heart of the system is the central emergency station from which the doors and hatch plates may be closed by starting the motors with which they are equipped. The working parts of the station are contained in a two-part watertight case secured to the side wall of the pilot house or other convenient place above decks. The apparatus of the station consists of three parts: the mechanism for controlling the circuits running to each door or hatch gear for closing the same; the lamps which indicate the closure of each door or hatch; and the fuse box in which each entering wire is supplied with its proper fuse. The accompanying photograph shows the emergency station as closed, and with the protective covering removed.

To operate the emergency station the officer in charge releases a hand wheel, which, in turn, releases a gear driven by a powerful spring and controlled by a suitable escapement. This gearing closes the circuits for operating the emergency switches located in the controller of each door and hatch gear. In performing this



function the gearing does not start all the motors at the same instant, for the reason that this would demand a large supply of current from the ship's generators. It starts them one after the other at about a three-second interval, so that it rarely happens that more than four motors are in operation at any one time, although the entire closure of twenty-four doors and hatch gears controlled from one emergency station may be accomplished normally in about a minute and a quarter. When, however, an extremely quick closing of all doors is required, this time can be reduced to thirty seconds for twenty-four doors by simply using the hand on the wheel of the emergency station to hurry it; and this action does not alter the closing speed of any individual door or hatch.

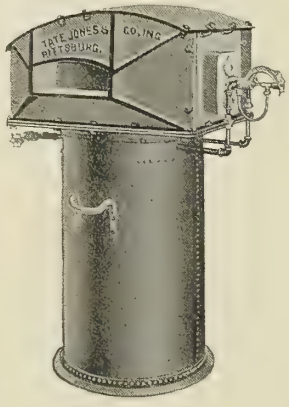
As each bulkhead door reaches its watertight seat, it automatically closes a circuit running to the emergency station, there connected with one of the small incandescent lamps. Transparent discs over these lamps bear numbers corresponding to the numbers of the various doors under control. The officer in charge, by pressing a button, can cause the indicator lamp of every closed door and hatch to glow, thereby assuring himself of the successful operation of the emergency action. If any door is prevented from closing by obstructions left in its path, this fact at once is apparent to the officer in charge, and no time need be lost in reaching the scene of the difficulty.

The emergency station contains but one spring, which furnishes the entire power for operating the device. This spring is of the helical type, and of ample strength for the work it is called upon to do.

Although the experience of hard sea-service has shown that the emergency station of the Long-Arm system can be depended upon for successful operation at all times, the mechanism can, if necessary, be actuated at any time by turning the hand wheel located in front of the case, should the station fail to act automatically by the power of the spring when released. During any emergency period a red indicator lamp glows continuously, so that a casual glance at the emergency station shows at once whether the emergency is "on" or "off." After a danger period is passed, and it is desired to again establish normal conditions below, the emergency may be thrown off by a hand reversal of the same operating device which is used to throw it on, so that the mechanism when not in use is always set ready to operate, and always available in time of need.

Oil Rivet Forges.

The illustration shows a forge designed for heating rivets, and used also for quite a variety of other work. The fuel is oil, which may be of almost any character, and which may be contained in the forge tank in sufficient quantity to last for two days. A blast is furnished by compressed air, which forces the oil to the burner and furnishes the air for atomizing the fuel. The pressure of this blast is reduced by a valve to twenty pounds. Both the air and the oil in the burner are controlled by one lever with fixed adjustment. The advantages claimed for this forge are: the small

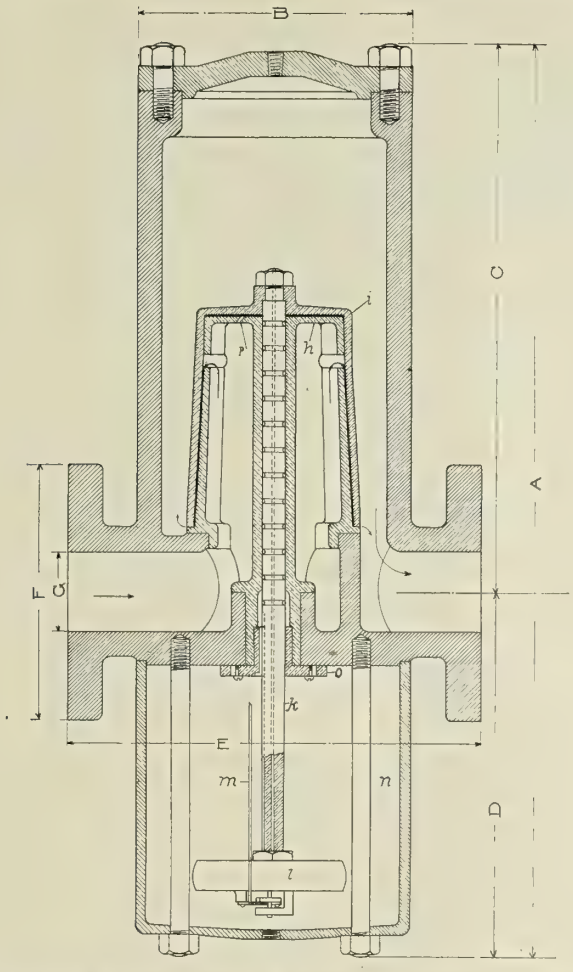


quantity of compressed air required; automatic regulation; a single valve for control; the perfect atomizing of the oil; and the limiting of the heating given the rivets to that required for riveting.

The machine, as placed on the market by Tate, Jones & Company, of Pittsburg, is built in two sizes, with capacities respectively of 800 and 400 ½-inch rivets per hour. The larger size weighs 750 pounds and consumes 1½ gallons of oil per hour; while the smaller size, of 400 pounds, consumes 1 gallon per hour.

The Sargent Steam, Gas, and Compressed-Air Meter.

This instrument is the outcome of a demand for a practical device which will measure or indicate the weight of steam flowing through a pipe. In the improved form, the meter is connected up in the steam pipe or by-pass, which allows all the steam that is to be measured to pass through, and this amount is indicated by the position of the needle on the dial. Meters are made so that the steam may flow in either direction, as desired. The sectional elevation of the meter shows the passage of the steam and the moving parts. Steam, entering from the left and rising around the valve-stem guide, passes through the small hole *p*, and raises the valve *i*. This allows the steam to pass down between the two cones and the valve seat to the discharge side. As the valve stem

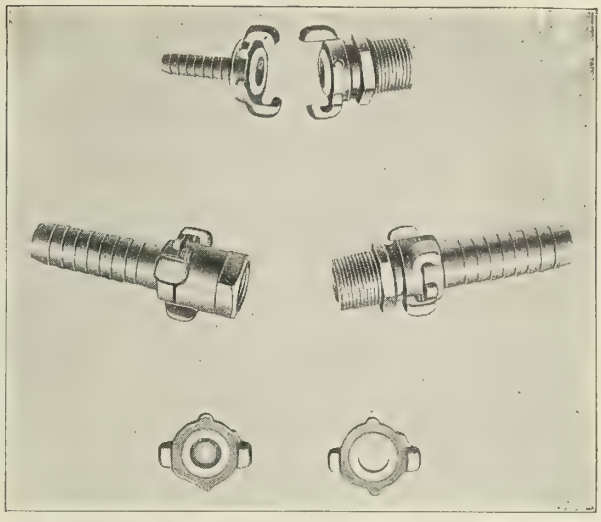


k is open to the atmosphere at the bottom, the pressure on the discharge side of the meter tends to close the valve and force it to its seat. Due to the area of the valve stem, there will be a difference of 2 percent in the pressure between the outlet and inlet sides. As the pressure increases, more steam will go through a constant opening; or, as the weight remains constant, the opening will be less. In order to compensate for variations in pressure, a Bourdon spring is connected to the bottom of the valve stem, and moves the needle transversely as the pressure varies. With a constant weight of steam flowing through, the valve would be open twice as wide for 50 pounds pressure as for 100 pounds, from which we see that the horsepower lines go down as the pressure goes up. The meter is calibrated by weighing the condensed steam flowing through under different pressures and valve openings, and the trial dial thus obtained is transferred to the permanent metal dial. As the meter has but one moving part, it is not liable to get out of order. It is manufactured in sizes from 1 to 6 inches by the Sargent Steam Meter Company, 1320 First National Bank Building, Chicago.

The Chicago Hose Coupler.

This device was designed to meet the demand for a universal coupler whereby a plant once standardized could be thereafter economically maintained standard without extra expense for specially-constructed couplers to suit various sizes of hose used with pneumatic tools. By reference to the illustration it will be observed the Chicago coupler has no male or female part at coupling end proper, but instead each half has embodied therein both male and female features whereby each and every half is exactly the same, and will couple regardless of the size and style of the shank, rendering the same a universal coupler in every sense of the word. It will readily be seen that quarter-inch hose may be coupled to three-quarter-inch hose, one-inch pipe, or anything having one of these couplers attached to it.

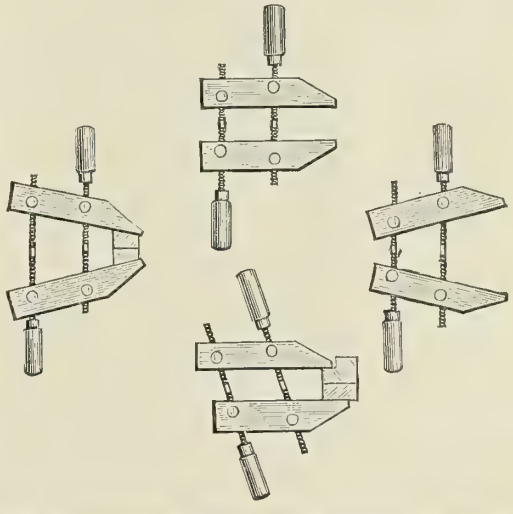
The shanks are manufactured for pipe male thread, pipe female



thread, and hose in standard commercial sizes, from one-quarter inch up to one inch, which enables all couplings to be made without resorting to reducers or special shanks, to meet the conditions presenting themselves where pneumatic tools are in use. The couplers are manufactured by the Chicago Pneumatic Tool Company, their facilities being equal to 500 sets per day.

The Jorgensen Clamp.

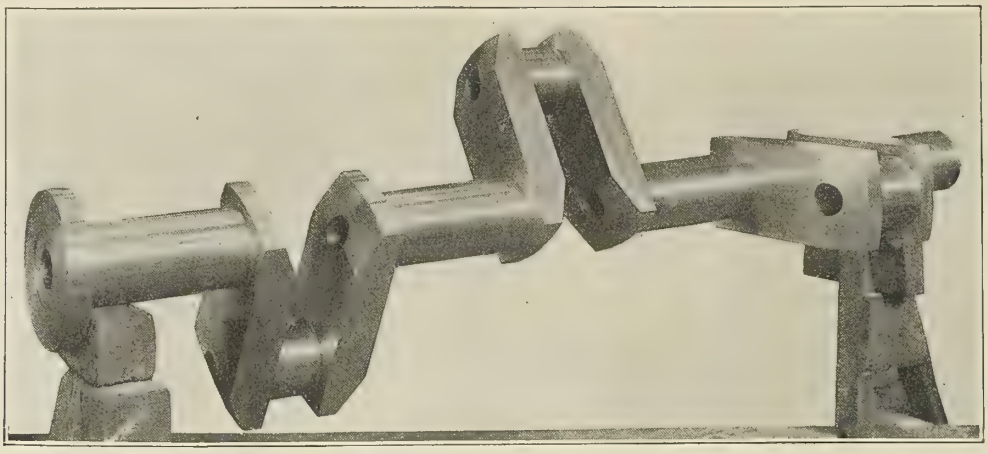
For the use of pattern makers, wood makers, machinists, and boat builders, the clamp of which we present illustrations is said to have considerable advantages over the old-style hand screw. The spindles are cold-rolled steel with right and left hand threads,



so that both jaws operate together and produce double the speed of the old arrangement, while it is possible to adjust a single clamp in any of the positions illustrated or any modifications of them. Adjustment is produced by the spindles passing through steel sockets in the jaws. These sockets revolve when necessary, and remove all friction between spindle and jaw. The makers are the Adjustable Clamp Company, 1031 Unity Building, Chicago, Ill.

Marine Forgings.

The illustration shows a forged steel marine triple-cylinder crankshaft, which was manufactured by the Sizer Forge Company, of Buffalo, N. Y., for the United States government. This style of crankshaft is probably the most difficult to manufacture of any of the marine cranks. The hollow boring of the shaft throughout demands that the ingot from which the forging is made be absolutely sound throughout, for if even a small hole were in the center of the ingot, and, therefore, in the forging, as the hammers cannot completely weld up these pipes, the drill which is used in hollow boring would follow such a hole, or pipe, and throw the boring out of center. While the hammers cannot



weld up holes in the ingots, they can greatly increase the density and strength of the steel. All steel castings are to a certain extent porous, especially toward the top of the ingot. Their porousness can be completely overcome if an ingot or billet enough larger than the forging is used to insure the proper working of the material. Another very essential point in obtaining satisfactory results in forgings, especially in the manufacture of crank shafts, is the using of a hammer which is sufficiently large and heavy, so that at each blow the center, and not only the outside of the ingot, or billet, is manipulated.

Another point that might bear mentioning here is the question of reducing, as far as possible, the strains which are caused by the hammer when forging. As the steel begins to cool the minute it leaves the furnace to go under the hammer, you might say that no two blows of the hammer are struck under equal strain conditions. The only way to overcome this difficulty is to do less hammering per heat than is the common practice, and then after the forging is ready for the machine shop to heat the job in its entirety to a uniform heat, and cool it equally in all parts. Large crankshafts, which have not been forged and treated under these conditions, are often out of line at the throw as much as ⅜ inch after the material between the throws has been slotted out preparatory to turning the pin; while similar cranks made under the process used by the Sizer Forge Company show about $\frac{1}{32}$ inch variation and sometimes none at all.

TECHNICAL PUBLICATIONS.

The Application of Graphic and Other Methods to the Design of Structures. By William W. F. Pullen. Second edition. Pages 341; figures 158. Manchester: The Technical Publishing Company, Ltd., 1905. Price five shillings net.

The first edition of this work was issued in 1896, and the second edition is very similar to the first, with the exception of the chapter on Struts, which has been rewritten and placed in more systematic form than was the case in the first edition. The work is one of a great deal of importance, particularly to engineers concerned with the design of bridges, cranes, roofs, and other structures on which the loads to be met are known with a greater or less degree of accuracy; and the methods of treatment coupled with a copious use of diagrams ought to render it very valuable.

Transmission of Heat Through Cold Storage Insulation. By Charles P. Paulding, M.E. Pp. 41 + 32; figures 7. New York: D. Van Nostrand Company, 1905. Price $1.00 net.

Based upon the experiments of the French physicist Péclet, and the laws deduced from them in his famous treatise on heat, the text of this little book has been designed as a working manual for engineers concerned with the construction of refrigerating rooms and cold-storage warehouses. Tables are given showing the relative heat conductivity of the various materials entering into the construction of such plants, and concrete examples for illustrating the use of the tables and giving an idea as to the method of obtaining results.

QUERIES AND ANSWERS.

All reasonable questions concerning marine engineering received from and signed by subscribers will be answered by the Editor in this column. All communications must bear the name and address of the writer.

Q. 305.—Will you kindly answer the following questions:

(1) How can I find mathematically the compression pressure (in pounds per square inch) in a gasoline engine whose cylinder is 6 inches diameter, 6 inches stroke, making 500 R.P.M., depth of compression space being 1½ inches?

(2) What will be the force of the explosion in pounds per square inch on the piston? M. F. G.

A.—(1) Without information regarding the time of closure of the exhaust valve of the engine you mention, it would be out of the question to find mathematically the compression pressure in pounds per square inch. It might be said off-hand, however, that with dimensions given an engine of the ordinary design ought to give an ultimate compression of nearly 100 pounds per square inch.

(2) The force of the explosion in pounds per square inch would depend largely upon the quality of the mixture of gas admitted to the cylinder, and would be found to be somewhere in the neighborhood of 300 to 325 pounds per square inch.

Q. 306.—Please explain the meaning of cylindrical coefficient, block coefficient, and midship-area coefficient, and oblige, Ingannus.

A.—If a rectangular mass of water with length, breadth, and depth equal respectively to the length, breadth, and draft of a ship be taken, and the volume of the submerged part of the ship compared with the volume of this water, the result will be the block coefficient of the ship. In other words, the block coefficient of a ship is equal to the ratio between the displacement of the ship itself and the volume of the circumscribing rectangular form.

The midship area coefficient is the ratio between the area of the immersed midship section of the ship and the area of a rectangle whose two dimensions are respectively the width of the ship and the draft amidships.

The cylindrical coefficient, which is frequently called the prismatic coefficient, is the relation between the actual volume of water displaced by the ship and the volume of a mass of water whose length is equal to that of the ship, and whose cross section, which is uniform in size and shape, is the same as the actual midship section of the ship.

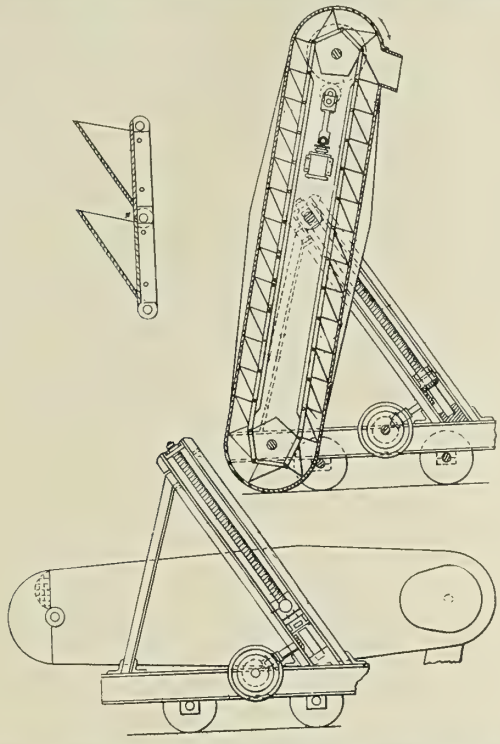
The block coefficient shows the general result of "fining" the ship both at the ends and around the bilges, while the cylindrical or prismatic coefficient shows the effect of fining simply at the ends, and is independent of the shape of the bilge, being figured from that as a basis.

We are informed that the Mississippi River dredge *Barnard*, which was described at length in our October number, was originally designed by Mr. Thomas Middleton, engineer of the Mississippi River Commission, who drew up the specifications under which she was built by the New York Shipbuilding Company.

SELECTED MARINE PATENTS.

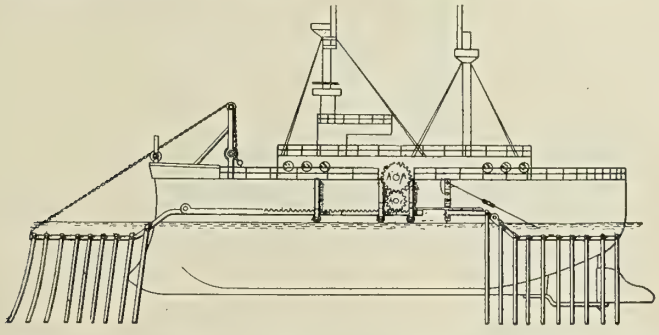
797,116. ELEVATOR FOR LOADING AND UNLOADING COAL, ETC. GERALD E. HOLLAND AND HENRY JOHNSTON, RANGOON, BURMA, INDIA, ASSIGNORS TO THE HOLLAND JOHNSTON PATENTS, LIMITED, OF LONDON, ENGLAND.

Claim.—3. An elevator comprising an endless chain of buckets, a casing forming a continuous trunk for said chain of buckets and having an open-

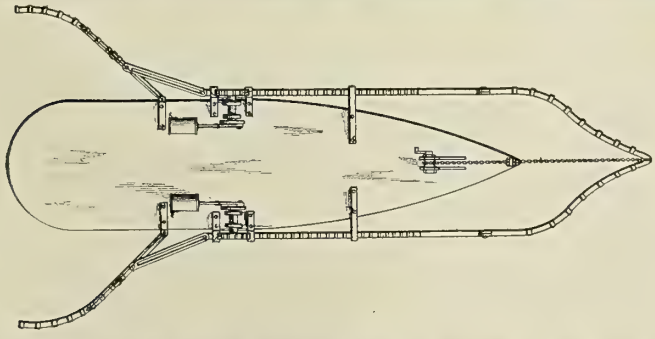


ing at each end thereof, a driving motor mounted between the limbs of said trunk, a suspension shaft secured to the casing above the center of gravity of the elevator, a frame having movable bearings for said shaft, and means for raising and lowering said bearings to tilt the elevator. Five claims.

797,235. WARSHIP. JOHN SLONKA, YONKERS, N. Y., ASSIGNOR OF ONE-HALF TO JOSEPH KAMP, YONKERS, N. Y.



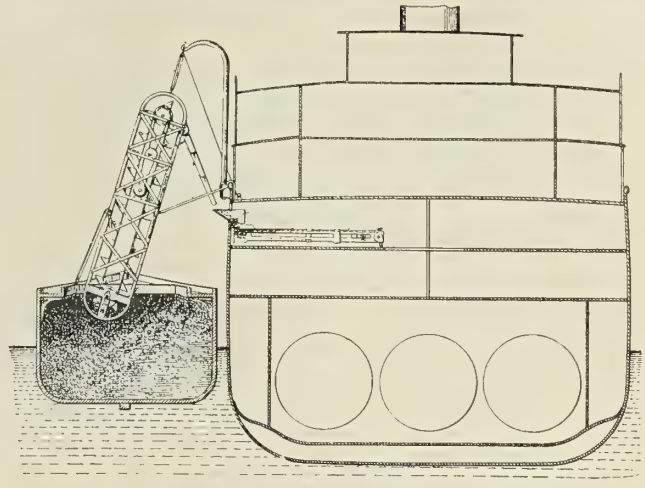
Claim.—1. A guard for vessels, comprising a front forwardly-projectable fender having rearwardly-extending bars provided with racks, rear pivoted



laterally-projectable fenders connected with and operated by said bars and pinions engaging the racks of said bars and reciprocating them. Four claims.

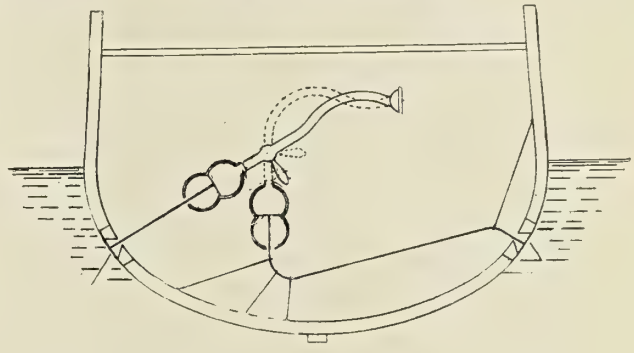
797,364. APPARATUS FOR COALING VESSELS. LOUIS A. DE MAYO, NEW YORK, N. Y.

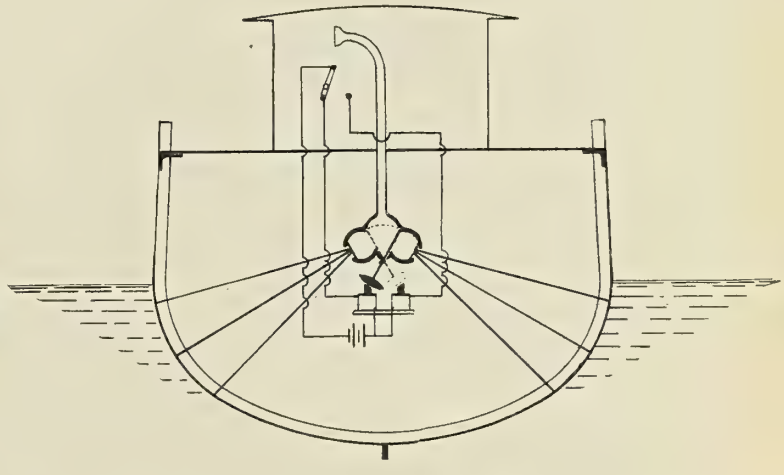
Claim.—1. In an apparatus for coaling ships, the combination of an elevator, means for mounting the same outside of the ship, a discharge chute leading from the elevator to the coal port of the ship, a distributer located within the ship and receiving the coal from the elevator discharge chute, and mechanism for driving the elevator and distributer; the said distributer comprising an apron and extensible frame sections. Thirteen claims.



798,202. SOUND-RECEIVING MEANS FOR SUBMARINE SIGNALING. JOSIAH B. MILLET, BOSTON, EDWARD C. WOOD, SOMERVILLE, AND HORACE B. GALE, NATICK, MASS., ASSIGNORS TO SUBMARINE SIGNAL COMPANY, OF WATERVILLE, ME., BOSTON, MASS., A CORPORATION OF MAINE.

Abstract.—The invention comprises primarily a wave-receiving diaphragm, so mounted in the ship or receiving station as to receive the incoming sound waves and to be vibrated thereby, preferably in contact with the water, although not necessarily with the open-sea water.



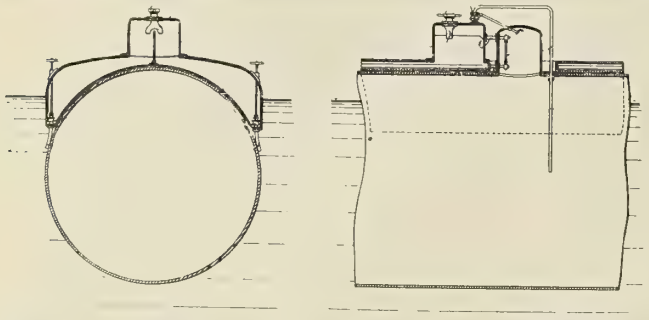


The invention comprises also receiving means which in some instances may act as resonating or intensifying means. Such means may be located at any convenient point, which may be in the immediate neighborhood of the receiving diaphragm on or near the side of the ship, or may be at a distance therefrom and at a point in the interior of the structure. As an element of the receiving means is another diaphragm, which for convenience we may call a "secondary" diaphragm. This secondary diaphragm is not necessarily of the size of the primary receiving diaphragm, but preferably and usually much smaller. The two diaphragms are connected, preferably, from their central points by a good sound conductor, the material of which is not important, but which depends to some extent upon circumstances—such, for instance, as the relative positions of the connected diaphragms. The conductor is relatively long and thin and extends tautly or comparatively rigidly between the two diaphragms. This vibratory connection, which may be a wire, rod, or cord, or the like, is very sensitive to vibrations the direction of which is along its axis, but is not sensitive to cross vibrations. It will therefore receive from the primary diaphragm, against which the sound waves impinge, only vibrations in the direction of its length and will deliver to and effectively operate the diaphragm of the receiving means through such vibrations only. In other words, the conductor will not receive and deliver to the last named or so-called "secondary" diaphragm any

of the vibrations ordinarily created by local disturbing agencies. By locating the receiving means at a point well within the ship or other structure and by making the sound conductor between the diaphragms relatively long several of the primary receiving surfaces may be connected to a single secondary receiving diaphragm or to a set of said diaphragms conveniently located, whereupon by means of a switching or selecting mechanism any receiving surface can be readily connected to the operator to enable him to determine by relative intensity of action from which direction the sound emanates. Twenty-three claims.

798,501. SUBMARINE BOAT. RAYMOND D'EQUEVILLEY, KIEL, GERMANY.

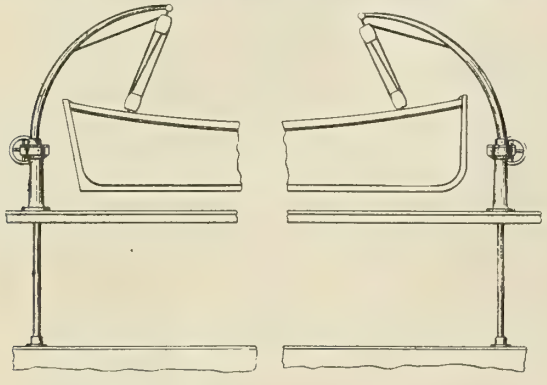
Claim.—4. In a submarine boat, a fuel reservoir arranged on the exterior of the boat, means providing communication between the interior of

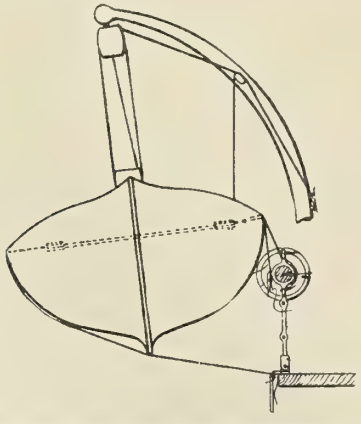


the boat and the upper portion of the reservoir, and means providing communication between the exterior water and the lower part of the reservoir. Five claims.

798,973. HOISTING AND LOWERING MECHANISM FOR BOATS. FRANK S. PETT, DOVER, ENGLAND.

Claim.—5. In a boat hoisting and lowering mechanism, the combination of mechanism for supporting the boat, a hinged drop-down spar adapted to



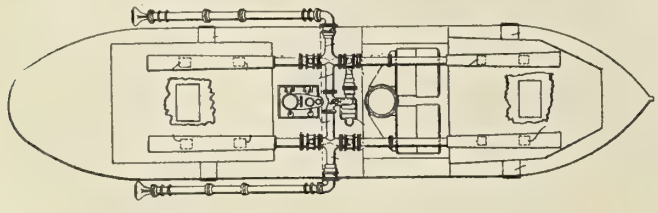


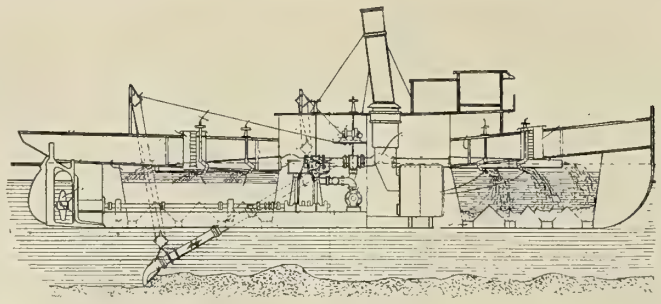
move inboard below the path of the boat supported by said mechanism as said boat is swung over the ship's side onto the deck thereof, and means for securing the spar in a normal closed position. Seventeen claims.

799,256. SUCTION DREDGE. LEVIN S. PARKER, NEW YORK.

Abstract.—The invention comprises specially-arranged bins for the dredged material and specially constructed and arranged pumping machinery and suction and discharge pipes leading to said bins, which preferably will be located forward and aft of the machinery space of the dredge.

One object of the invention is to provide highly-efficient pumping and suction apparatus or machinery in the use of which the dredged material will not pass into contact with the pump mechanism, but will be induced to



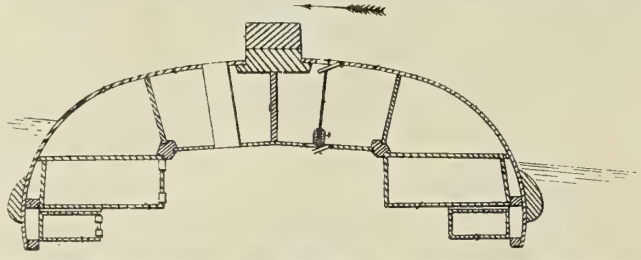


flow through the connected suction and discharge pipes by means of an auxiliary stream of water delivered by the pump into the said discharge pipe, said pump taking its supply of water through a separate pipe leading through the side or bottom of the dredge.

A further object of the invention is to so construct and arrange the suction and discharge pipes and bins that the dredge may be kept properly trimmed and that pumping the material against any material head may be avoided, said bins being decked over in a substantial manner and at such height from the keel of the ship that when the bins are filled with sand their tops are even with the load water-line. Sixteen claims.

799,378. LIFEBOAT. H. J. HEDDERWICK, GLASGOW, SCOTLAND.

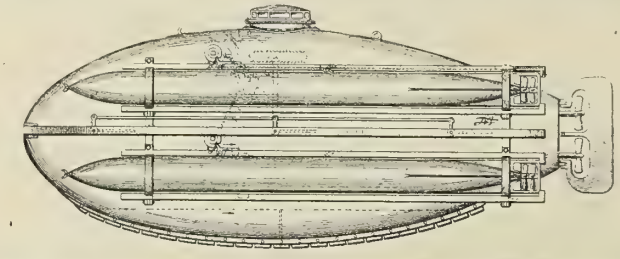
Claim.—6. A lifeboat having end and side longitudinal airtight compartments, in combination with a series of water-charged cases located on one side of the center line of the boat, and a series of cases located upon the



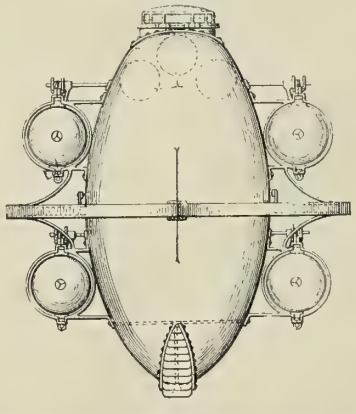
opposite side, provided with top outlets and base inlets fitted with valves, coupled together by a rod, in combination with a series of cases with top inlets and base outlets formed therein located at one side of the boat, together with a series of airtight cases located upon the opposite side of the boat, fitted and arranged for the purposes substantially as set forth. Eight claims.

800,101. SUBMARINE TORPEDO BOAT. JOHN J. HARPAIN, OF THE UNITED STATES NAVY.

Claim.—5. In a submarine boat, the combination with a series of frames grouped symmetrically on opposite sides of and exterior to the boat, and torpedoes mounted in said frames, of means carried by said frames for



locking the torpedoes therein, means operated from the interior of the boat for releasing each torpedo when desired, and spring-actuated means also operated from the interior of the boat for moving the torpedo forward and for setting the motive power of the torpedo in operation.



36. In a submarine torpedo boat, the combination with the hull of the boat of a guard rail mounted exterior to the hull of the boat, a series of immersion rudders pivoted between said guard rail and said hull, tillers for said rudders mounted exterior to the boat, a rod on each side of the boat connected to all of the tillers on that side, and a lever mounted in the interior of the boat and simultaneously operating both of said rods, and ballast tanks and detachable weights for bringing said boat to an even keel, and trimming same laterally. Fifty claims.